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TWENTY-SEVENTH ANNUAL REPORT

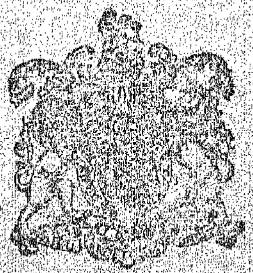
OF THE

SUPERINTENDING ENGINEER,

PUBLIC HEALTH DEPARTMENT,

UNITED PROVINCES,

FOR THE YEAR ENDING 31st MARCH, 1922



ALLAHABAD:
Printed by the Superintendent, Government Press, United Provinces.
1922

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Twenty-seventh Annual Report of the Superintending Engineer, Public Health Department, United Provinces, for the year ending 31st March, 1922.

Government in notification no. 3211-E., dated the 6th October, 1921, changed the designation of the head of this departmnet to Superintending Engineer, Public Health Department, United Provinces, which is considered a more appropriate term.

Staff :—

Mr. G. McC. Hoey continued to hold the post of Superintending Engineer, and Mr. Raja Ram acted as his Personal Assistant throughout the year.

Mr. C. F. Hunter held charge of the 1st Division up to 12th May, 1921, when he was transferred to the post of Under Secretary to Government. Mr. C. F. N. Leahy, who was at that time attached to the 1st Division, held charge during the rest of the year.

Mr. S. E. Platt, Executive Engineer, 2nd Division, when proceeding on one year's leave on the 26th October, 1921, was replaced by Mr. F. D. Tunnicliffe.

Mr. I. Walker was attached to the 2nd Division, but owing to ill-health was invalided from service on the 13th June, 1921.

Mr. K. Chattopadhya, Assistant Engineer, held charge of the 3rd Division till the 25th January, 1922. Mr. G. E. Rhodes, Executive Engineer, Public Works Department, Buildings and Roads branch, whose services have been transferred to this Branch, took over the charge of this Division on the 26th January, 1922, and held the post till the close of the year.

Mr. J. N. Mitra, Assistant Engineer, held charge of the Well-Boring Operations Division throughout the year.

In addition to the above, Mr. F. J. Mallett, Mechanical Engineer for Water-works, two Assistant Executive Engineers, seven Assistant Engineers, thirty-six subordinates, and the requisite number of draughtsmen were also employed in this branch.

The Superintending Engineer visited Cawnpore, Agra, Meerut, Dehra Dun, Lucknow, Naini Tal, Muttra, Mussoorie, Saharanpur and Calcutta during the year.

He also visited Bombay to attend the annual meeting of the Institution of Engineers (India), and Gwalior State, on deputation, to advise the Durbar on work in connection with the visit of His Royal Highness the Prince of Wales.

The Mechanical Engineer for Water-works visited all open water-works stations in these provinces and in his reports offered the Boards valuable advice.

Expenditure.—The sum of Rs. 27,05,870 was spent on construction (original works), and Rs. 14,45,598 on maintenance and repairs of open water-works under Superintending Engineer's supervision.

The establishment charges of this department for the year under review amounted to Rs. 3,60,000.

An amount of Rs. 2,94,209 was earned in fees for projects completed during the year and an amount of Rs. 43,800 realised. Fees due from local authorities amount to Rs. 1,16,921.

Fees earned and realised for construction carried out departmentally amounted to Rs. 1,53,571.

Owing to the delay of Municipal Boards to submit their returns in reasonable time this report can with difficulty be printed by the prescribed date. Returns from Benares and Naini Tal were very late and no returns at all were received from Jhansi even by 31st May.

United Provinces Boiler Act.—Several appeals from the decision of the Chief Boiler Inspector were heard during the year and decisions recorded. Cases have come to notice where the Act seems to require modification in view of recent advances in boiler manufacture and design. Such cases have been duly repor[illegible] to Government.

Water-works—General.--The outstanding features of municipal supplies are the failures of the Boards to exercise control over their distribution and check waste, to adjust taxation to meet added running charges, and the starving of works as regards funds for repairs and improvements. Frequent applications to Government for grants-in-aid are made to cover items rightly debitable to maintenance. Appeals to Government for help have been generously met hitherto, which course apparently inculcates a reliance on grants-in-aid to meet deficits. It deserves serious consideration whether in future grants-in-aid should be given in any but the most exceptional circumstances.

Water meters are not provided in sufficient number, nor are those meters which have been installed kept in proper repair. Extensions of the distribution and private connections are granted without thought of their effect on the system, and the Boards do not realize the necessity for keeping accurate records of their supply system.

There are systems in operation where some areas receive a supply of over 100 gallons per head per diem of the population served, while other areas receive practically no water at all. This state of affairs has been engendered by years of neglect.

There is no municipal water supply in these provinces which could not easily be made self-supporting if reasonable care was exercised in its management, nor indeed should there ever be any necessity for grants-in-aid to meet the cost of extensions and renewals.

In cases where Boards constantly fail to maintain their supply, a possible solution of the difficulty might be to hand the system over to a private company on equitable terms, assuring the public of an efficient supply.

The question of regular and satisfactory supply of coal still causes anxiety and many Boards judge the suitability of their coal by the price and not by its calorific value. A tendency has also been noticed for Boards to use coal supplied for water supply pumping, for brick and lime burning. Cases have come to notice where no credit for coal used in this way has been made to the water supply.

The suggestion made in a previous year that Boards should combine in the matter of coal supply contracts has not met with any response.

Shortage of water supply is reported from all municipalities and the fact that the supplies are being run at a loss in most instances renders extensions of the water supply a difficult proposition. No municipality is entitled to sympathy until it seriously tackles the question of waste, and increases its taxation to cover running expenses. Such economies are intimately bound up with any steps for improvements and extensions.

A reference to Appendix I reveals the serious state in which the water supplies stand at present. In all cases, excepting Allahabad, heavy losses on the year's running are recorded. As Allahabad has not paid any sinking fund and interest during the last two years, the returns show a phantom profit. The amount of deficit recorded varies from Rs. 1·37 lakhs at Benares to Rs. 8,900 at Muttra. To meet this state of affairs, the water rates, (which should be the basis of all water supply revenue) ought to be considerably increased. Boards who fail in these steps have no claim for help from Government in the way of grants-in-aid or even in loans.

Water analyses.—Periodical analyses of water supplied by the various open water-works show that the supply was of uniformly good quality except at Allahabad, where over 55 per cent. of the total number of samples tested failed to come up to the required standard. This was the subject of special investigations by the Mechanical Engineer, which showed that the sand of the filter beds was insufficiently supported and that unfiltered water was passing round the inlet pipes to the clear water channels below. The majority of the inlets will have to be altered and the filters re-sanded. One of the clear water reservoirs was pumped out for inspection, and cracks of a serious nature, undoudtedly of long standing, were discovered in the flooring, buttresses, arches and side walls of the reservoir.

The roof also allows surface water to percolate through. Contamination takes place by incessant leaks through the cracks in the walls and roof. The Municipal Board are still considering the question of repairing this reservoir.

Pumping machinery.

Agra.—The plant has been maintained generally in a good state of repair. The new Belliss sets have been taken over and are running satisfactorily. The time is approaching when consideration will have to be given to the installation of additional pumping plant for the unfiltered supply. During May and June the main source of the Jumna dried up and a temporary supply from the Secundra canal was arranged. The much-needed cleaning of the settling tanks could not be done owing to paucity of funds combined with difficulty of obtaining labour.

The Municipal Board show great reluctance to face the matter of waste prevention, and refused the grant offered by the Board of Public Health for this purpose. This Board is not entitled to any further help in the shape of grants-in-aid until it realizes its responsibility concerning waste prevention.

Allahabad.—Several inspections of the works were made during the year. Greater efforts have been made during the last few months of the year under review to give effect to recommendations made some time ago. The plant at both the filtered and unfiltered stations still requires close watch, particularly at the unfiltered station where much remains to be done to ensure a reasonable state of security. The main pump girders were found to be loose last February, and although special instructions were given to have them made secure, no effective steps were taken with the result that the pump and engine parts are being unduly stressed. A new air vessel has recently been fitted replacing the temporary work installed when the old vessel fractured in August, 1920. In July last the pump rod of "A" engine at Khusrubagh snapped while working, but no serious damage resulted and a spare rod was substituted.

The coal shortage at Allahabad has been notorious and despite Government orders for seeking assistance in such circumstances no applications for help were received.

Benares.—The pump work at the filtered station has been improved and one new barrel and bucket fitted, but there is considerable anxiety regarding the old geared engines at the unfiltered station. A tube in one of the boilers burst and five men were scalded. The cause of the burst was the subject of an enquiry by the Boiler Department. It is hoped that a decision will soon be arrived at regarding the re-organization scheme with which is bound up the question of waste and the raising of taxation. The Board have not yet accepted the offer of the Board of Public Health to provide funds for the installation of additional meters and the provision of staff for waste prevention.

Cawnpore.—There have been numerous changes in the staff. All the pumps have been overhauled and are in fair working order as far as machinery, most of which is old, is concerned. Two new pump bodies have been fitted to the Vertical Worthington pumps at the unfiltered station and a new L. P. cylinder to the High Duty Worthington at the filtered station. No progress has been made with the development of the workshops to manufacture spare parts, nor have the Board seriously tackled the question of waste prevention. There are numerous complaints regarding shortage of water and lack of pressure. The demand for water has outgrown the capacity of the plant at the unfiltered station. No orders for additional machinery have been placed by the Improvement Trust who have undertaken the re-organization of the water supply on behalf and at the instance of the Board. The waste prevention question and the raising of taxation are serious questions demanding the consideration of the Municipal Board.

Lucknow.—Spare parts were obtained and fitted to the rotary engine at the unfiltered station, and the engine generally overhauled and adjusted. A piston rod broke on the old Vertical Worthington and a cylinder cover was cracked. These were made good. The engines and pumps at the filtered station were maintained in a good state of repair. Two of the headers in one of the water-tube boilers at the filtered station burst. This accident was the subject of an enquiry by the Boiler Department. The new works at Aishbagh under the re-organization scheme are in progress, and it is hoped that the shortage of water will be alleviated in a year's time. No effective steps have yet been taken by this Board to counteract waste.

Meerut.—The machinery has been maintained in running order, but a new rotor is required for one of the turbines, as the old one is practically worn-out. The shortage of water is acute and no time should be lost in bringing into use the supply from the recently constructed tube well. This well when tested yielded 740 gallons per minute with eleven feet depression—the largest yield of any well yet sunk in these provinces.

Naini Tal.—The pumping plant has been overhauled, but is practically worn-out The inspection of the boilers has not been completed this year. One boiler has been in use since November, 1921 without a licence for which no satisfactory explanation is forthcoming. The new pumping plant under the re-organization scheme is being installed and it is hoped will be running in a few months.

Jhansi.—The engines and pumps require some new parts fitting, and a more reliable feed water supply to the boilers. The shortage of water is acute and a large proportion of the public obtain their supply from open wells.

Muttra.—The pumping plant has been maintained in very good order. One tube well is showing signs of choking, but a good supply is obtained from the other three.

Mussoorie.—The plant has been well maintained, and orders have been placed for the pump spare parts recommended. Acute shortage of supply in May and June is reported and the Board will be well advised to commence work on the supplementary pumping station. The storage reservoirs recently constructed have alleviated distress to some extent.

Original water-works.—The installation of motor-driven centrifugal pumps in the Thornhill Road and Mayo Hall wells has been completed and these wells will shortly be made over to the municipality. The well at Daraganj with a vertical spindle centrifugal pump and belt drive to a Campbell oil-engine has also been completed. The bearings of the latter quarter twist drive have given a little trouble by heating and adjustments are being made to overcome this.

Tube wells.—At Fatehgarh Central Jail the tube well was completed and handed over to the Jail authorities. The sinking of a 15″ tube at Farrukhabad has been completed down to 260 feet below ground and arrangements for lowering the strainer are being made. Tube wells at Meerut, the Saw Mills and Wood-Working Institute at Bareilly, Pokhrayan and Ferozabad were completed and successfully test-pumped. The East Indian Railway tube well at Cawnpore was also completed. At Tundla the 15″ pipes are being withdrawn. This well was abandoned as reported last year as no water bearing strata was found. Tools and plant have been collected at site, at Sikandra, Agra and the District Jail, Aligarh, and boring work will shortly be commenced at both places.

Four trial bores for geological survey purposes were completed on the bank of the Gumti river at Lucknow, and four in the bed of Sindh river at Jhansi. The bores in connection with the hydrographic survey at Benares were completed.

Magh Mela water supply.—A temporary water supply was provided at Daraganj and water was supplied to pilgrims at the mela and to adjoining localities without a breakdown during the whole period of the mela.

The influx of pilgrims to the mela caused an increase of nearly one million extra to the resident population.

Dehra Dun.—An estimate and plan for a filtered gravity supply from the Tons river amounting to Rs. 11 lakhs has been accepted by the Municipal Board, who have agreed to the extra taxation necessary and have applied to Government for a loan to commence construction.

Lucknow water supply re-organization.—The estimated cost of the complete scheme is about Rs. 45 lakhs, and this work constitutes the largest in hand in this department. The construction of the Paterson filtration plant is now well advanced. One settling tank has been remodelled. The contract for the supply of pipes and fittings for the 27″ rising main from Gaughat to Aishbagh has been let. Work will shortly commence on the generating station foundations.

Four Babcock's water tube boilers and fittings have been received from England and also a considerable amount of materials for the overhead high tension transmission lines.

Water mains have been laid along the Clyde and Bandariabagh roads.

Naini Tal Hydro-Electric Supply.—The cost of this work is now estimated to amount to almost Rs. 21 lakhs. The progress during this year was excellent and but for delays and damage to materials on rail the electric supply could have been made available to the public by April, 1922. The two 10-inch power pipe lines have been completed, except for one or two special pieces ; the transmission and distribution lines have been completed with the street lighting circuits. The Pelton wheels and alternators have been fixed on their foundations. Two sub-stations have been completed with switch boards and transformer connections. The water supply pumping station building is complete, but it will not be possible to get the pumping plant ready before August, 1922.

In addition to these, work on Haldwani water supply, Ramnagar water supply, and Gola Gokarannath tank improvement and water supply was started during the year under report and is still under construction.

Fyzabad water supply.—Funds have been allotted and tenders called for piping, reservoir and pumping plant. Construction will shortly commence. The estimated cost of the work is over Rs. 9 lakhs.

Drainage—General.—Local authorities as a rule devote very little money to drainage improvements, all the larger works being financed by grants-in-aid by Government.

Where sewers exist the number of house connections made is surprisingly small. The public in the large towns have not commenced to realise the benefits of a water borne system of sewerage. Extensive use is made of pail dépôts to save cartage of night-soil, and many instances have come to light where pail dépôts and even manholes are used to dispose of street sweepings and rubbish. This practice is persisted in, in some cases, although frequent blockage of sewers takes place and even though it entails great expense and inconvenience in cleaning sewers.

The sewage pumping stations at Allahabad and Cawnpore have been kept running fairly efficiently, but at Allahabad no attempt has been made to derive full benefit from the sewage pumped. At certain seasons the sewage is allowed to overflow from the farm and cause a nuisance in the river.

At Allahabad also owing to failure to maintain the motors for the sludging gear in order, the sumps were filled up with solids causing a stoppage of pumping and a great nuisance to the public by the overflow of sewage. This trouble has now been rectified by the Municipal Board.

Allahabad drainage.—The work on Kydganj and Bai-ka-bagh sewerage has been completed and handed over to the Municipal Board in working order. The Naini sewage farm project has been practically completed, but as the Agricultural Institute of Allahabad has come forward with a proposal to utilize all extra sewage and as the terms of an agreement are now being discussed with the Municipal Board, proposals for financing this work have been held in abeyance.

Agra drainage.—The Municipal Board has indefinitely postponed consideration of the drainage project. The Shahganj drainage work, which is financed from provincial funds, is in course of construction.

Moradabad.—The drainage improvement work has been completed at a total cost of about Rs. 55,000 and work on the flushing system is in hand.

Cawnpore.—The Permit pumping station has been completed and handed over to the Municipal Board. The value of work aggregated Rs. 64,000. A survey for the sewage farm is still in hand and has been delayed by pressure of other work.

Lucknow.—Work on the sewage pumping station and farm, as far as the temporary arrangements are concerned, has almost been completed and the station and farm will shortly be handed over to the Municipal Board.

The life of a workman was lost owing to asphyxiation from sewer gas and great difficulty is experienced at this pumping station owing to the huge quantities of solids brought down. This is owing to the use of manholes by sweepers as a dumping place for rubbish and street sweepings.

Work on the western intercepting sewer has also been completed and the several minor sewerage projects such as the trans-Gumti, the cis-Gumti, and the Bandariabagh schemes have been completed.

Muttra.—Work on the Holi Darwaza sewer has been satisfactorily completed. Frequent complaints are received concerning the contamination of the Jumna stream at Dhuru Ghat—the present outfall. A project for disposing of the Muttra sewage by pumping on to a farm on the left bank of the Jumna is now in hand. The Chairman and the Board take a keen interest in their drainage work, but are handicapped by lack of funds.

The water supply standpost drainage has been completed at a total cost of Rs. 10,000.

Dehra Dun.—Drainage supplementary work was finished during the year at a cost of Rs. 58,000.

Work at the Arhat Bazar also, after certain alterations and great opposition, was finished during the year. The total cost amounted to about Rs. 13,000.

At Benares the survey and observation work to ascertain the cause of landslips at the Manikarnika and Baji Rao Ghats has been completed. A report will be shortly submitted.

Drainage work at Nagina has been completed and that at the Gola Gokarannath tank is in progress. Drainage works at Khurja and Sardhana in Meerut district have been held up at the request of the Municipal Boards.

Departmental work in general.—Much trouble was occasioned by either total loss or delay in delivering materials for construction on the railways. The recent strike on the East Indian Railway practically brought works to a standstill for want of materials.

The Municipal Boards generally show little tendency to recognize the necessity for employing competent engineer staff. They are loath to increase taxation to meet the capital charges for necessary public works and rely on receiving grants-in-aid from Government towards almost every work they undertake.

They also rely on this branch to carry out their construction for them and when they encounter trouble in maintenance owing to lack of skilled supervision, they are not slow to place the blame on this department. The tendency is to force this department not only to accept responsibility for technical advice and construction, but also for maintenance. It is possible that technical advice and financial help has been given too freely in the past and the time has perhaps come when a halt should be called to grants-in-aid and when pressure should be brought to bear on Boards to employ engineers properly qualified to undertake maintenance, prepare projects and to carry out construction.

A tendency has been noticed during the past year for some Boards to encourage private enterprise in the matter of electricity supply, for instance the Moradabad, Saharanpur and Aligarh Boards are endeavouring to get their electricity supplies carried out by private enterprise.

The time has also come when the question of permitting private companies to undertake public water supplies should be considered and a Water-works Act drafted. This course would relieve Government of a considerable amount of responsibility and also benefit the public by a more efficient water supply.

Superintending Engineer wishes to acknowledge the valuable assistance given him during the year by Mr. F. J. Mallett and Messrs. Leahy, Tunnicliffe, Rhodes and Raja Ram. The work of Babu Lajpat Rai and Babu Balram Das also deserves special mention.

G. McC. HOEY,
Superintending Engineer,
Public Health department, United Provinces.

The 20th May, 1922.

APPENDICES.

"Messrs. Chattopadhya and Raja Ram were appointed Lecturers to the University of Lucknow, for water-supply and sanitary engineering. The Superintending Engineer and Mr. Raja Ram conducted the examinations in these subjects for the Licence in Public Health and Diploma in Public Health of the University."

APPENDIX

Statement of operatio of

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
Population.				
1. By Census of 1921 in municipality.	163,902	145,653	195,373	195,498
2. By Census of 1921 in cantonments.	22,044	11,567	3,074	21,580
3. Number of inhabitants drawing their supply from mains.	185,946	157,220	195,373	195,498
Consumption of water.				
4. During the year including cantonments, in gallons.	1,496,641,500	1,298,931,600	2,077,941,000	2,124,500,000
5. Water used for trade, in gallons.	65,496,000	149,128,610	59,032,000	314,909,923
6. Ditto municipal supplies, in gallons.	157,971,328	207,616,800	...	Nil
7. Water used for domestic purposes, in gallons.	1,273,174,172	942,186,190	2,018,909,000	1,809,590,077
8. Daily average including cantonments, in gallons.	4,100,387	3,558,716	5,692,988	5,820,548
9. Daily average for cantonment alone, in gallons.	273,500	305,376	2,366	39,798
10. Maximum daily average in any month, in gallons.	4,294,122	4,702,348	8,884,504	6,699,032
11. Consumption per head per day for trade, in gallons.	·97	2·59	·82	4·41
12. Consumption per head per day for municipal supplies, in gallons.	2·32	30·2	...	...
13. Consumption per head per day for domestic purposes, in gallons.	18·76	16·42	28·31	25·36
Total ...	22·05	22·63	29·13	29·77
14. Hours of supply daily ...	10·27	12·75	7·35	15·90
Lift of pumps.				
15. From river to settling tanks, feet	47·00	113·33	98·29	105·74
16. From filtered water pumps to town distribution, feet.	141·78	68·76	78·13	73·25
Total lift, feet ...	188·78	182·09	176·42	178·99
Supply connections.				
17. Total number of house connections (assessment).	2,809	4,353	10,885	4,547
18. Number of house connections (assessment) made during 1921-22.	266	137	269	334
19. Total number of metered house connections.	95	383	2	674
20. Number of metered house connections made during 1921-22.	15	84	Nil	73
21. Total number of metered trade connections.	18	45	Nil	150
22. Number of metered trade connections made during 1921-22.	8	1	Nil	2

No. I.

rious water-works in the United Provinces for the year 1921-22.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
217,167	77,711	12,943	16,517	34,092	54,385	55,032	42,615
23,399	44,898	2,346	802	Nil	12,069	Nil	10,235
177,935	122,609	12,000	17,319	34,092	25,000	38,400	42,615
1,259,286,000	527,029,000	66,354,000	41,011,600	65,910,000†	53,423,950	168,192,000†	262,458,000†
4,353,600	14,109,300	...	338,400	...	478,625	20,280,000	3,480,211
247,543,000	3,963,500	...	93,820	...	1,360,000	Not available.	31,024,000
1,007,389,400	508,956,200	66,354,000	40,579,380	65,910,000	51,585,325	147,912,000	227,953,789
3,450,098	1,443,915	181,792	112,360	180,576†	146,367	460,800†	719,063†
447,813	529,213	1,121	5,088	Nil	17,874	Nil	Nil
4,063,539	1,672,778	216,820	287,930	648,721	180,275	473,122	977,200
·07	·32	...	·053	...	.052	1·45	·22
3·81	·09	...	·014	...	·149	...	1·99
15·51	11·37	15·14	6·42	5·29	5·65	10·55	14·65
19·39	11·78	15·14	6·487	5·29	5·851	12·00	16·86
12·1	14·00	24·00	13·56	24·00	11	24·00	10·8
103·96	15·16	Main. 1,700·0	H. L. 1,141·00	Gravity	161·66	Gravity	...
64·01	112·41	Aux. 600·00	I. L. 439·50	Supply	...	Supply	137·83
167·97	127·57	...	L. L. 254·50	...	161·66	...	137·83
2,639	1,038	1,164	272	17	31	522	581
152	10	9	16	...	...	154	136
63	...	368	267	14	4	431	...
12	...	6	16	...	...	*Nil*	...
...	34	...	25	...	1	87	21
...	17	...	5	...	...	6	6

†Excluding cantonments.

APPENDIX

Statement of operations of various water-wo

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
Annual charges and cost of water supplied.				
23. Maintenance charges, Rupees ...	1,49,711	1,60,640	2,61,500	3,97,339
24. Interest and sinking fund, Rupees.	68,285	*	86,204	63,781
25. Cost per 1,000 gallons per 100 feet lift, Annas	·847	1·088	1·139	1·67
26. Cost per 1,000 gallons maintenance charges, Annas.	1·60	1·97	2·01	2·99
27. Cost per 1,000 gallons interest and sinking fund charges, Annas.	·73	*	·66	·48
28. Cost per 1,000 gallons including maintenance, interest and sinking fund charges, Annas.	2·33	1·97	2·67	3·47
Income from Water-works.				
29. Water rate recovered (assessment), Rupees.	99,173	1,96,322	1,95,814	2,94,323
30. Sale of water by meter, Rupees	72,256	78,260	Nil	88,425
31. Other receipts, Rupees ...	2,711	2,529	14,758	11,688
Total Income, Rupees ...	1,74,140	2,77,111	2,10,572	3,94,436
Income and working charges.				
32. Receipts per 1,000 gallons supplied through meters, Annas.	3·93	8·39	Nil†	4·49
33. Receipts per 1,000 gallons supplied through assessment rating, Annas.	1·24	3·3	1·55	2·60
34. Receipts per 1,000 gallons supplied on total consumption, Annas.	1·86	3·41	1·62	2·97
35. Loss per 1,000 gallons supplied (item 28—item 34), Annas.	·47	Profit 1·44	1·05	·50
36. Deficit on year's working, Rupees	43,856	,, 116,471	137,132	66,684

* Not paid, Rs. 1,34,520. Last year's instalment Rs. 1,34,520 also not paid.
† No meter rate.

No. I—(concluded).

in the United Provinces for the year 1921-22—(concluded.)

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
2,28,014	44,910	49,207	84,586	7,115	15,297	18,412	28,86
1,20,705	43,152	32,996	23,014	7,504	2,983	23,012	10,96
1·73	1·07	·87	5·23	...	2·83	...	1·2
2·90	1·36	11·86	32·99	1·72	4·58	1·75	1·7
1·53	1·31	7·95	8·98	1·82	·89	2·18	·6
4·43	2·67	19·81	41·97	3·54	5·47	3·93	2·4
86,858	A*7,957	43,874	38,620	...	7,383	...	27,88
1,75,687	62,051	12,679	19,045	2,049	298	20,493	3,05
26,787	...	1,783	3,870	...	248	566	...
2,89,332	70,008	58,336	61,535	2,049	7,929	21,059	30,94
6·45	4·69	...	21·87	27·75	9·96	...	8·
1·38	·204	10·57	15·06	A†	2·28	...	1·
3·67	2·13	14·06	24·00	·497	2·37	2·00	1·
·76	·54	5·75	17·97	3·043	3·10	1·93	·
59,387	18,054	23,867	46,087	12,570	10,351	20,365	8,8

A * Ferrule rating.

A † No charge is made for supplying water.

APPENDIX No. II.

Annual maintenance accounts of water-works during the year 1921-22.

Names of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
I.—Establishment—												
(*a*) Permanent establishment ...	32,478	48,815	56,317	54,522	48,173	19,430	8,611	15,120	4,959	2,139	4,913	16,463
(*b*) Office contingencies ...	1,334	1,123	1,307	1,200	602	3,176	634	510	39	398	194	9
(*c*) Rent	240	1,514	135	...	350	60	...	...	...	...	...	...
II.—Pumping—												
(*a*) Coal	66,620	79,948	141,982	160,552†	130,910	1,994	28,275§	57,872	...	9,996	...	6,695
(*b*) Oil and waste	10,619	9,084	10,270	12,113	5,945	1,345	5,024	1,798	...	256	...	1,352
(*c*) Other stores	4,623	8,217	7,320	28,573	6,864	6,210	1,142	679	...	233	...	1,435
III.—Intake—												
(*a*) Training river	3,947	...	...	790	...	...	...	...	...	...	...	...
(*b*) Cleaning channels and wells ...	4,518	...	...	...	...	69	...	...	...	...	...	116
IV.—Settling tanks and filters—												
(*a*) Cleaning, settling tanks and wells	...	...	1,199	1,307	7,748	80	...	...	...	61	...	...
(*b*) Cleaning and renewing filter beds	6,348	1,013	1,682	15,000	627	1,679	...	...	...	...	...	...
(*c*) Purchase of sand	12,500	2,369	...	10,181	10,336	1,095	...	...	...	...	...	...
(*d*) Purchase of allumino feric ...	...	...	4,598	15,348	...	3,025	...	...	...	...	...	...
V.—Distribution—												
(*a*) Pipes and fittings ...	2,047	529	25,828	12,121	8,459	2,792	268	3,830	2,007	396	1,690	319
(*b*) Meters	...	...	...	23,436	1,020	...	364	375	...	...	6,200	31
(*c*) Standposts or hydrants ...	...	...	...	...	...	...	...	...	...	...	900	179
VI.—Repairs—												
(*a*) To tanks	409	...	...	145	...	224	270	359	...	50	3,716	...
(*b*) To buildings and grounds ...	1,116	835	1,885	1,409	670	917	791	265	...	90	109	1,295
(*c*) To machinery	2,722	4,012	7,918	25,265	5,220	1,380	3,494	2,722	...	150	...	973
(*d*) To rising main	...	...	1,028	...	...	...	...	...	...	...	...	...
(*e*) To tools and plant ...	...	...	...	...	...	...	...	396	...	...	...	...
VII.—Water analyses	140	3,081	31	187	1,090	234	334	660	110	...	690	...
VIII.—Cost of water—												
Canal Department dues ...	nil.	100*	...	35,190	...	1,200	...	...	...	1,528	...	...
Total ... Rs.	1,49,711	1,60,640	2,61,500	3,97,339	2,28,014	44,910	49,207	84,586	7,115	15,297	18,412	28,867
Interest and Sinking Fund Charges .. Rs.	68,285	‡	86,204	63,781	1,20,705	43,152	32,996	23,014	7,504	2,983	23,012	10,966
GRAND TOTAL ... Rs.	2,17,996	1,60,640	3,47,704	4,61,120	3,48,719	88,062	82,203	107,600	14,619	18,280	41,424	39,833

* Test run on Daraganj tube wells.

† Includes charges for electricity canal pumping Rs. 15,831.

‡ Not paid Rs. 1,34,520. Last year's instalment Rs. 1,34,520 also not paid.

§ Cost of energy.

APPENDIX No. III.

Statement showing initial capital cost, subsequent extensions and improvements and expenditure chargeable to capital on water-works in the United Provinces for the year ending 31st March, 1922.

Number.	Water-works stations.	Initial capital cost.	Cost of subsequent extensions.	Expenditure during the year.	Total.
		Rs.	Rs.	Rs.	Rs.
1	Agra	11,70,761	18,76,473	37,264	30,84,498
2	Allahabad	16,24,061	8,88,189	1,10,738	26,22,988
3	Benares	25,61,881	8,04,884	6,640	33,73,405
4	Cawnpore	14,44,570	10,92,732	...	25,37,302
5	Lucknow	15,15,736	9,50,459	11,23,214	35,89,409
6	Meerut	7,51,710	55,388	3,315	8,10,413
7	Mussoorie	4,79,754	2,35,641	69,892	7,85,287
8	Naini Tal	2,47,000	4,22,439	369	6,69,808
9	Dehra Dun	97,241	83,629	...	1,80,870
10	Jhansi	96,556	61,521	2,983	1,61,060
11	Mirzapur	6,29,508	42,155	10,000	6,81,663
12	Muttra	5,17,288	20,362	10,263	5,47,913

APPENDIX No. IV.

Statement showing rate of filtration and results of water analyses of the United Provinces water-works during 1921-22.

Municipalities.	Filter area out of operation per million gallons pumped, sq. feet.	Rate of filtration in gallons per square foot per day.			Chemical analysis.			Bacteriological analysis.		Mechanical filter samples
		Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.	
Agra ...	5051·30	34·00	22·00	31·71	2	3	5	88	17	7
Allahabad ...	9777·26	50·00	12·25	35·92	8	...	8	891	497	...
Benares ...	4198·36	54·00	12·50	40·49	38	...	38	439	24	...
Cawnpore ...	348·31	66·00	9·00	42·15	3	...	3	829	18	...
Lucknow ...	3176·40	50·00	6·20	25·72	6	...	6	399	23	...
Meerut ...	4126·91	37·50	21·00	32·89	3	...	3	241	34	...
Mussoorie ...	...	...	...	...	4	...	4	27	12	...
Naini Tal ...	...	...	...	...	5	..	5	121	24	...
Muttra ...	...	...	...	...	7	4	11	25	1	...

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising mains, etc.,

Particulars		Agra.	Allahabad.	Benares.	Cawnpore.
1. Floor levels:—					
Unfiltered station ...		505·00′	296·00′	254·00′	375·00′
Filtered station ...		505·00′	321·25′	263·00′	410·00′
2. Highest water level during the year.		494·00′	255·50′	221·00′	398·00′
3. Lowest water level during the year.		479·00′	240·55′	195·00′	356·60′
4. Particulars of plant ... Unfiltered station ...		2. Diesel sets ... 1. L. D. Worthington. 2. Geared sets ...	1. Triple Ex-Rotary. 2. Beams ...	1. H. D. Worthington. 2. Geared sets ...	1. Triple Exp. Rotary. 2. Triple Ex. Vertical L. D. Worthington.
			...	...	...
Filtered station ...		2. Beams ... 2. Belliss and Morcom. 1. H. D. Worthington.	2. Beams ...	2. Pairs of coupled Beams.	1. H. D. Worthington. 2. L. D. Worthington.
5. Capacity of pumps.	G. P. M.	...	...	...	...
Unfiltered station.	,,	Diesels 3,000 each	Triple 2,700	H. D. 8,333	Triple 3,625
	,,	L. D. W. 1,700	Beams 2,100 each	Geared sets 4,200 each.	L. D. 3125 each
	,,	Geared 2,500 each	..	...	...
	,,	...	...	...	...
Filtered station	,,	Beams 3,000 each ...	Beams 3,100 each	Beams 7,500 each	H. D. 4,719
	,,	Belliss 2,500 each ...	...	Set (2 engines) ...	L. D. 3,125 each ...
	,,	H. D. W. 2,500 ...	...	...	...
	,,	...	...	...	...
6. Number of rising mains		Two	Two	Two	Two
7. Length and size of rising mains.		2·5 miles 28″ ... 1·75 miles 18″ ...	3·8 miles each 20″	Old ·89 mile ... New ·77 mile each 24″.	1·32 miles each 20″

No. V.

in [illegible] *water-works of the United Provinces for* 1921-22.

Lucknow.	Meerut.	Mussoorie.	Naini Tal	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
367·50′	735·50′	Main.5494·56′			751·05′		
395·00′	735·50′	Aux.6,000·00′					
355·00′	805·00′				767·50′		
341·70′	771·00′				746·20′		
One triple Exp. Rotary one vertical. L. D. Worthington.	Two turbines and one semiportable engine.	...	Lake station steam pumps.	...	Two compound Worthington pumps.	...	Two Mirrlees Bickerton Diesel engines.
...	...	Two main pumps electrically driven, three throw reciprocating pumps single reduction gearing.	Main pumping station 3 L. D. Worthington.	...	...	...	Motor driven centrifugal pumps.
One H. D. Worthington 2 L. D. Worthington.	Two turbines	Two aux. pumps as above, but with double gearing.	...	...	...	...	...
...	...	...	...	...	...	...	1,400 each.
Triple 3125	1,200	...	Lake. 239	...	...	...	...
L. D. 3125	each	...	...	...	...	...	...
...	...	Main 182 Aux. 80	One. 218	...	220 each	...	...
H. D. 3125	1,100	...	Two 86				
L. D. 3125	each	...	each	...	...	...	...
each.	...	...	...				
One	Two	Two	Five	...	Five	One gravitation main	One,
3·5 miles 20″	7·25 miles 15″ 1·61 „ 13″	1·13 5″ ·26 3¼″	·93 miles 4″ ·66 miles 3½″ ·34 „ 3″ ·49 „ 4″ ·25 „ 5″	...	(1) 3·65 mile 9″ (2) 0·70 mile 6″* (3) 1·6 miles 6″ (4) ·57 mile 4″ (5) ·95 mile 3″.	5·73 miles 12″	·91 mile 12″.

*Partly replaced by 9″.

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising mains, et

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
8. Number of settling tanks	Five.	Three.	Three.	Three.
9. Size of settling tanks ...	266′ × 151′ ...	280′ × 180′ ...	403·5′ × 252·5′ × 15′ each.	343·5′ × 243·5′ × 13·5′ each.
10. Capacity of settling tanks	2,200,000 each ...	1 and 3 = 4,400,620 2 = 4,455 626.	1 and 3 = 6,436,120 2 = 6,508,927.	Each = 5,923,664
11. Number of filters ...	7 + 1 mechanical	Six	Eight	Seven
12. Size of filters ...	Sand 200′ × 100′ each.	200′ × 100′	200′ × 100′	200′ × 100′
13. Number of clear water reservoirs.	3	2	2	2
14. Size of clear water reservoirs.	103′ × 105′ × 10′	160′ × 103·3′ × 12′.	$178\frac{1}{3}$′ × $148\frac{1}{3}$′ × 12′.	135′ × $106\frac{2}{3}$′ × 12′
15. Capacity of clear water reservoirs.	676,000 each ...	1,248,000 each ...	1,854,068 each ...	953,300 each ..
16. Number of service reservoirs.	3	1	1	2
Size	1·66′ × $11\frac{1}{3}$′ deep 2·20′ × 50′ deep	60′ × 11′ deep	60′ × 15′ ...	(1) 50·5′ × 36′... (1) 50·5′ × 40′ ...
17. Number of public standposts.	One tap 190 Two taps 73 Four taps 68 Waste not Tyler's taps } 18 Push cocks 7 Bibcocks 15	One tap 144 Two tap 62 Four tap 82 W. N. Cocks 22 Push cocks 27 Wall boxes 7 Bibcocks 6	One tap ... 208 Two taps ... 109 Four taps ... 81 Wall fountains 35	One tap ... 122 Two taps ... 52 Tour taps ... 90 Bathing platform ... 5
18. Number of fire hydrants	145	144	54	148
19. Number of road watering posts or standpipes.	44	13	162	12
20. Number of cattle troughs	44	29	8	18

No. V—(concluded).

[illegible]n the water-works of the United Provinces for 1921-22—(concluded).

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Debra Dun.	Jhansi.	Mirzapur.	Muttra.
Three	Three	C. W. R.	...	...	...	...	...
250′ × 200′ × 13·6′ each	100′ × 60′ × 11′ each.	Six 2—40 × 25 × 8′	...	...	...	...	...
Each 4,000,000.	528,000 each	1—30 × 20 × 8′ 1—80 × 24 × 6′	...	...	...	...	...
Seven 200′ × 100′	Four 150′ × 100′	1—79·3 × 38 × 11′ 1—45 × 53·5 × 11′	One chlorine plant.	...	...	...	...
		Service					
2	1	15	1	...	...	...	...
105′ × 107′ × 12′ 798,500 each	48′ × 52½′ × 7′ 110,600	1—10′ × 10′ × 4′ 9—8′ × 4′ × 4′	45′ × 40′ × 6′ 67,500	...	...	...	...
1	2	5—4′ × 4′ × 4′	82 small 6 large service tanks.	30	1	1	2
66′ × 12′	25′ × 34′ each.				40′ × 15′ × 8′	200′ × 75′ × 14′	each. 32′ × 20 feet.
One tap 204 Two taps 229	¾″ one tap 43 ¾″ two taps 90 Wall fountains 3 ½″ taps 4	Stand-posts One tap 1 Two taps 34	Small reservoirs. 32—3′ × 3′ 29—2′8″ × 3′ 1—4′ × 3′ 3—4′ × 5′ 17—square tanks 6′ × 8′ × 4′ Large tanks 1—36′ × 15′ × 9·5′ 2—22·5′ × 13·33′ 1—29·5′ × 15 × 9·5′ 1—20′ × 10′ 1—18′ × 10′	12	Two taps 10 7 Tanks 6 taps each. One service tank with 50 taps.	71	One tap 36 W. S. pipe 49 Two taps 55 Stand pipe 5
352	91	...	...	...	...	118	8
89	Swan neck 9 R. W. cocks 82.	15	...	...	1	Nil	4
26	17	5	...	4	3	6	8
							Urinal connections 2 Flushing pipe 8

APPENDIX No. VI.

Detailed statement of the expenditure incurred on works of sanitary nature executed under the supervision of the Superintending Engineer, Public Health department, during the year 1921-22.

No.	Names of places.	Water-works original and special repairs.	Water-works maintenance.	Drainage works.	Other works.	Total.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	Agra	37,264	1,49,711	4,073	3,219	1,94,267
2	Allahabad ...	1,10,738	1,60,640	16,157	...	2,87,535
3	Benares ...	6,640	2,61,500	...	6,052	2,74,192
4	Cawnpore ...	...	3,97,339	2,570	...	3,99,909
5	Lucknow ...	11,00,000	2,28,014	5,30,149	...	18.58,163
6	Meerut ...	3,315	44,910	...	...	48,225
7	Mussoorie ...	69,892	49,207	...	...	1,19,099
8	Naini Tal ...	369	84,586	...	6,53,058	7,38,013
9	Dehra Dun ...	...	7,115	17,492	...	24,607
10	Jhansi ...	2,983	15,297	...	...	18,280
11	Mirzapur ...	10,000	18,412	...	...	28,412
12	Muttra ...	10,263	28,867	18,000	...	57,130
13	Deoband ...	...	...	9,982	...	9,982
14	Sardhana ...	...	...	2,144	...	2,144
15	Gola Gokarannath...	9,422	...	...	19,931	29,353
16	Khurja ...	...	...	569	...	569
17	Nagina ...	...	...	8,461	...	8,461
18	Hardwar ...	2,337	...	...	...	2,337
19	Moradabad ...	4,134	...	46,656	...	50,790
	Total ...	13,67,357	14,45 598	6,56,253	6,82,260	41,51,468

APPENDIX No. [illegible]II.

Comparative statement of working expenses of various water-works in the United Provinces for 1921-22.

Number.	Names of water-works.	Class of work, gravitation or pumping.	Fuel consumed.	Fuel consumption per 1,000 foot gallons.	Price of fuel per ton.	Total lift including friction.	Percentage of charges for—					Per 1,000 gallons.		Per head of total population per annum.			Remarks.
							Establishment.	Fuel.	Oil and waste.	Repairs to machinery.	Other charges.	Total working cost.	Total receipt.	Total working cost.	Total receipt.	Loss.	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
			Tons. Cwt.	Lbs.	Rs a. p.	Feet.						As.	As.	As.	As.	As.	
1	Agra ...	Pumping ...	2,547 0	·0201*	20 2 6	188·78	21·61	44·49	7·09	1·81	25·00	2·33	1·86	18·75	14·98	3·77	*Coal and Fuel combined.
2	Allahabad	Ditto ...	4,612 16·75	·0436	17 5 3	182·09	30·39	49·77	5·59	2·50	11·75	1·97	3·41	16·35†	28·20	Pro. 11·85	†I and S. F. not paid.
3	Benares ...	Ditto ...	6,237 4	·0381	22 12 0	176·42	21·54	54·30	3·92	3·02	17·22	2·01	1·62	28·03	16·97	11·06	
4	Cawnpore	Ditto ...	4,926 5	·0290	29 6 0	178·99	13·72	40·41‡	3·05	6·36	36·46	3·47	2·97	33·98	29·07	4·91	‡Includes electrical charges also.
5	Lucknow	Ditto ...	5,754 9	·0609	22 11 11	167·97	21·13	57·42	2·61	2·29	16·55	4·43	3·67	23·19	19·24	3·95	
6	Meerut ...	Turbines worked by water power.	...	...	...	127·57	41·46	4·44	2·99	3·07	48·04	2·67	2·13	11·49	9·13	2·36	
7	Mussoorie	Pumping ...	...	...	...	1700·00 600·00	17·50	57·46§	10·21	7·10	7·73	19·81	14·06	86·02	61·04	24·98	§Cost of energy.
8	Naini-Tal	Pumping and gravitation.	907 16	·0788	63 11 9	1141·00 439·50 254·50	17·88	68·42	2·12	3·22	8·36	41·97	24·00	99·40	56·84	42·56	
9	Dehra Dun	Gravitation ...	...	...	...	Gravity Supply	69·70	...	...	...	30·30	3·54	·497	6·86	·96	5·90	
10	Jhansi ...	Pumping ...	698 6	·181	14 5 0	161·66	13·99	65·34	1·67	·98	18·02	5·47	2·37	4·40	1·91	2,49	
11	Mirzapur ...	Gravitation ...	...	...	...	Gravity Supply	26·68	...	...	...	73·32	3·93	2·00	12·04	6·12	5·92	
12	Muttra ...	Pumping ...	40 13	·003136‖	132 2 10	137·83	57·03	23·19	4·68	3·38	11·72	2·43	1·88	12·05	9·36	2·69	‖Fuel oil only.

APPENDIX F.

Statement showing initial capital cost, details of income and expenditure for water-works in the United Provinces for the year 1921-22.

Serial number.	Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
1	Description of plant	Oil engine and steam power.	Steam power.	Steam power.	Steam power.	Steam power.	Water and steam power.	Hydro-Electric power.	Steam power and gravity.	Gravitation.	Steam power.	Gravitation.	Oil engine.
2	Initial capital cost in lakhs ... ... Rs.	11·71	16·24	25·62	14·45	15·16	7·52	4·80	2·47	·97	·97	6·30	5·17
3	Total cost of works in lakhs ... ,,	30·84	26·23	33·73	25·37	35·89	8·10	7·85	6·70	1·81	1·61	6·82	5·48
4	Number of inhabitants drawing their supply from mains	185,946	157,220	196,885	195,498	177,935	122,609	12,000	17,319	34,092	25,000	38,400	42,615
5	Hours of supply daily	10·27	12.75	7·35	15·90	12·1	14·00	24·00	13·56	24·00	11·00	24·00	10·3
6	Quantity supplied during year in million gallons ...	1496·64	1298·93	2,077·94	2124·50	1259·29	527·03	66·35	41·01	65·91	53·42	168·19	262·46
7	Maximum daily average during any one month in thousand gallons.	4,294	4,702	8,884·50	6,699	4,064	1,673	217	288	449	180	473	977
8	Average daily supply for the year in thousand gallons ...	4,100	3,559	5,693	5,821	3,450	1 444	182	112	181	146	461	719
9	Maximum supply per head per day	23·09	29·90	45·47	34·27	22·83	13·64	18·07	16·62	19·02	7·21	12·32	22·93
10	Average supply per head per day	22·05	22·63	28·91	29·77	19·39	11·78	15·14	6·487	5·29	5·851	12·00	16·86
11	Total lift in feet	188·78	182·09	176·42	178·99	167·97	127·57	Main 1,700 Aux. 600	H L. 1,141.00 I. L. 439·50 L L. 254·50	Gravity Supply	161·66	Gravity Supply	137.83
12	Quantity supplied during year in million foot gallons ...	282,536	236,522	366,424	380,264	211,522	67,233	89,591	25,799	...	8,636	...	36,175
13	Fuel consumed ... ... Tons.	2,547	4,612·8	6237·2	4,926·2	5,754·5	154·5	...	907·82	...	698	...	50·6
14	Fuel consumption per million foot gallons ... lbs.	20·1	43·6	38·1	29·0	60·9	...	...	78·83	...	181	...	3·14
15	Cost of fuel per ton ,, ... Rs.	26-2-6	17-5-3	22-12-0	29-6-0	22-11-11	...	...	63-11-9	...	14-5-0	...	132-2-10
16	Cost of establishment per million foot gallons Annas.	1·84	3·32	2·46	2·29	3·64	4·63	1·53+	9·37	...	3·96	...	7·28
17	Cost of fuel per million foot gallons ... ,,	3·77	5·41	6·20	6·75	9·90	·47	5·05+	35·89	...	18·51	...	2·96
18	Cost of oil and waste per million foot gallons ,,	·60	·61	·44	·50	·45	·32	·89	1·11	...	·47	...	·60
19	Cost of repairs to machinery per million foot gallons ,,	·15	·27	·34	1·06	·39	·33	·62	1·68	...	·27	...	·42
20	Cost of other charges per million foot gallons ,,	2·11	1·27	1·95	6·09	2·86	4·94	·68	4·33	...	5·10	...	1·49
21	Total ,,	8·47	10·88	11.39	16·69	17·24	10·69	8·77	52·43	...	28·31	...	12·75
22	Maintenance charges per thousand gallons supplied ,,	1.60	1·97	2·01	2·99	2·90	1·36	11·86	32·99	1·72	4·58	1·75	1·76
23	Interest and sinking fund charges per thousand gallons supplied. Annas.	·73	Nil†	·66	·48	1·53	1·31	7·95	8·98	1·82	·89	2·18	·67
24	Total (maintenance and interest and sinking fund) per thousand gallons supplied. Annas.	2·33	1·97	2·67	3·47	4·43	2·67	19·81	41·97	3·54	5·47	3·93	2·43
25	Maintenance charges in thousand ... Rs.	149·71	160·64	261·50	397·34	228·01	44·91	49·21	84·59	7·11	15·29	18·41	28·87
26	Interest and sinking fund charges in thousands ,,	68·28	†	86·20	63·78	120·70	43·15	32·99	23·01	7·50	2·98	23·01	10·97
27	Total income in thousands ... ... ,,	174·14	277·16	210·57	394·44	289·33	70 01	58·34	61·53	2·05	7·93	21·06	30·94
28	Profit or loss on maintenance in thousands ... ,,	+24·43	+116·47	—50·93	—2·90	+61·32	+25·10	+9·13	—23·06	—5.06	—7·36	+2·65	+2·07
29	Profit or loss on maintenance and interest and sinking fund in thousands. Rs.	—43·85	+116·47	—137·13	—66·68	—59·33	—18·05	—23·86	—46·07	—12·56	—10·34	—20·36	— [illegible]90
30	Deficit percentage on total cost of works in 1,000 ,,	1·42	Pro 4.44	4·0	2·62	1·65	2·22	3·03	6·88	6·94	6·4	2·81	·62

† Interest and S. F. not paid this year. + Cost of energy.

APPENDIX No. VIII.

A.—List of projects finally sanctioned during the year 1921-22.

	Amount of estimate. Rs.
Agra: Water supply, additional mechanical filters	1,08,170
Allahabad: Unfiltered water supply (revised estimate of Daraganj raised reservoir)	19,598
Allahabad: Magh Mela water supply for 1921-22	12,329
Banda: Tube wells in District Jail	13,084
Dehra Dun: Water supply improvements	291
Do. Arhat Bazar drainage (Revised estimate) ...	21,000
Do. Drainage estimate for providing hydrants and hose to water flushed latrines (revised estimate)	2,544
Firozabad: Tube well supplementary estimate	2,950
Fyzabad: Water supply	9,93,890
Gola Gokarannath: Improvement scheme	83,749
Do. Water supply	30,239
Gobardhan: Trial bore with masonry cylinder	10,972
Hardwar: Water supply to pilgrims at Adh Kumbh Mela ...	5,912
Lucknow: Water supply re-organization (alterations to settling tank no. 1)	3,098
Lucknow: Water supply re-organization (filtration plant) ...	4,17,165
Do. Bandariabagh water supply	16,382
Do. Extension of water main on Clyde Road... ...	3,291
Do. Sanitary fittings for Hazratganj police station ...	17,336
Do. do. Executive Councillor's residence	11,393
Do. do. residence of the President of the Legislative Council	13,388
Lucknow: *Chaine-helice* pumps	924
Do. *Sewage pumping station, treating* with Novoid powder the floor of the pump well	1,102
Lucknow: Sewage pumping station and farm (revised estimate)	9,33,063
Meerut: Tube well no. 1	15,808
Nagina: Drainage improvements (revised estimate)... ...	13,357
Naini: Sewage farm survey	150
Nimsar: Drainage scheme	45,821
Ramnagar: Water supply improvement	28,592
Do. do. do. (supplementary estimate)	3,608
Rikhikesh: Special repairs to storm water drain and sewer ...	2,192
Shahganj: Drainage scheme (revised)	73,856
Saharanpur: Trial bores across Krishni river	2,371
Total ...	29,07,625

B.—List of projects submitted but not sanctioned during 1921-22.

	Rs.
Aligarh: District Jail tube well	9,812
Allahabad: Retesting the polo ground tube well	4,459
Do. Sewage farm project	2,86,159
Do. *Independent tube well in Alfred Park*	69,916
Balrampur: Drainage scheme (revised)	11,17,037
Baldeo: Drainage and Khirsagar tank improvements (abstract estimates).	
Scheme A.—(With canal supply)...	87,770
Scheme B.—(With tube well supply)	1,12,967
Benares: Water supply and electricity scheme (preliminary proposals)	46,43,237
Bijnor; Drainage, water supply and flushing scheme ...	1,77,000
Cawnpore: Sewage farm (rough forecast)	10,60,000
Do. Overflow at the junction of old and new intercepting sewer	1,284
Cawnpore: Water supply and sewerage connection pertaining to *Industrial School*	40,000
Dehra Dun: Water supply	11,15,714
Firozabad: Test pumping tube well	2,950
Fyzabad: Circuit house sanitary fittings	60,000
Gobardhan: Tube well with masonry cylinder	25,287
Do. Trial bore without masonry cylinder	5,815
Carried over ...	88,19,407

	Rs.
Brought forward	88,19,407
Haldwani : Water supply improvement	26,103
Khurja : Drainage improvements	29,968
Lucknow : Water supply re-organization, distribution system	20,86,927
Do. do. do. clear water reservoir, generating station	19,59,953
Lucknow : Trans-Gomti drainage scheme	15,13,643
Do. do. sewerage scheme	6,00,000
Do. do. do. (right bank of Gomti river)	24,301
Lucknow : Bandariabagh sewerage scheme	4,11,793
Do. Temporary work in the sewerage system	4,686
Lucknow : Water supply for Indian Girls' School	2,687
Lucknow : Sanitary fittings for new Kutchery Road	1,27,175
Moradabad : Drainage improvements (supplementary estimate for constructing a 50″ circular sewer in front of Sheikh Muhammad Hussain's house)	8,110
Moradabad : (2nd revised estimate for flushing scheme, tube well)	27,518
Muttra and Brindahan Electric Supply: (preliminary proposals) Scheme A	12,87,543
Mussoorie : Sewerage, Happy Valley Section (preliminary proposal for sewage disposal works)	39,163
Naini Tal : Sanitary fittings for Ramsay Hospital—	
1st Alternative	38,468
2nd Do	29,813
Pilibhit : Drainage scheme	8,00,000
Do. Water supply	3,00,000
Rampur : Storm drainage	20,686
Kikhikesh : Rough estimate of various sanitary measures (preliminary proposals)	4,14,445
Roorkee : New water supply to Thomason Engineering College	1,78,735
Saharanpur : Hydro-Electric supply	13,32,352
Tundla : Salving 12″ casing pipe	4,345
Type design of Dried Meat Factory	80,341
Ujhani : Drainage and flushing scheme (revised preliminary proposals)	4,09,498
Total	205,77,660

C.—List of schemes under preparation with the approximate estimated amounts.

	Approximate amount. Rs.
Allahabad : Unfiltered water supply (revised scheme)	2,78,000
Brindaban : Drainage	10,00,000
Do. Water supply	4,00,000
Fatehpur-Sikri water supply	1,11,000
Gola-Gokarannath water tight-steining well	15,000
Hathras : Water supply (preliminary proposal)	8,50,000
Kaimganj : Drainage scheme	1,50,000
Kosi : Tube well (revised estimate)	23,400
Moradabad : Flushing scheme (revised estimate)	2,50,000
Meerut : Drainage (preliminary proposal)	35,00,000
Muttra : Drainage (revised estimate)	13,00,000
Muzaffarnagar : Flushing scheme	1,78,482
Naini Tal : Hydro-Electric Scheme (revised estimate)	20,73,387
Sikandra : Tube well (revised estimate)	53,000
Total	1,01,82,219

TWENTY-SIXTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31ST MARCH, 1921.

ALLAHABAD:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS, UNITED PROVINCES.
1921.

No. 1839 /M-29

From

G. McC. Hoey Esqr.,
Sanitary Engineer to Govt,
United Provinces.

To

The Chairman,
Municipal Board,
Naini Tal

Dated Allahabad the 16th June, 1921.

Sir,

I have the honour to ford for information one copy of Sanitary Engineer's Anl Report for the year ending 31st March, 1921.

I have the honour to be,
Sir,
Your most obedient servant,
Raja Ram
16-6-1921
For Sany Engineer to Government,
United Provinces.

Regr. [illegible]
[illegible] [illegible] [illegible] [illegible]
to [illegible]
15/6/21

Regr. [illegible]
102
15/6/21

Submitted
[illegible]
20/6/21
[illegible]
21/6/21

Enclosure:-
1 Report.

C.C.B.

To Chairman
Portions affecting [illegible] Chalkes [illegible]
1/7/21

[illegible]
[illegible] [illegible]

TWENTY-SIXTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

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ALLAHABAD:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS, UNITED PROVINCES.
1921.

Twenty-sixth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March, 1921.

Establishment.—The post of Sanitary Engineer was held throughout the year by Mr. G. McC. Hoey.

The following officers were employed in the Sanitary department under the Sanitary Engineer:—

(1) Mr. C. F. Hunter, Executive Engineer, held charge of the First Sanitary Division, Saharanpur, throughout the year.

(2) Mr. S. E. Platt, Executive Engineer, held charge of the Second Sanitary Division from 1st April to 13th June, 1920, and from 5th November to the close of the year. During his absence on leave Mr. Mohammad Ishaq Khan, Assistant Engineer of this department, was put in charge of this division.

(3) Mr. K. Chattopadhya, Assistant Engineer, held charge of the Third Sanitary Division, Lucknow.

(4) Mr. J. N. Mittra, Assistant Engineer, held charge of the Well Boring Operations Division throughout the year. Mr. E. W. Clarke worked as Personal Assistant to the Sanitary Engineer from 1st April to 30th September, 1920, on which date he was transferred as Executive Engineer, Dehra Dun. Mr. Raja Ram, Assistant Engineer, worked as Personal Assistant from 21st February, 1921 to the close of the year.

Mr. F. J. Mallett, an experienced Mechanical Engineer, joined this department on 28th December, 1920, with the rank of Superintending Engineer.

The following Assistant Sanitary Engineers also joined this department on 28th December, 1920, and were posted to the divisions noted against their names:—

Captain C. F. N. Leahy	First Sanitary Division.
,, W. Saise	
Major F. D. Tunnicliffe	Second Sanitary Division.
Captain I. Walker	
Mr. G. K. Pillai	

In addition to the two Assistant Engineers in charge of the Third Sanitary Division and Boring Division, 9 Assistant Engineers, 1 Upper Subordinate, 9 Temporary Upper Subordinates, 2 Mechanical Upper Subordinates, 41 Lower Subordinates, 48 Draftsmen, and the necessary clerical staff, accountants, and work establishment were employed in this department.

The following stations were visited by the Sanitary Engineer during the year:—

Agra, Allahabad, Benares, Cawnpore, Lucknow, Meerut, Mussoorie, Naini Tal, Dehra Dun, Muttra, Saharanpur, Moradabad, Gorakhpur, Bareilly, Hardwar, and Deoria. He also visited Delhi to see sanitary works of interest there, Ajmer to advise on drainage questions, and Calcutta to attend the Inaugural Meeting of the Institution of Engineers (India).

Expenditure—The sum of Rs. 9,40,701 was spent on original sanitary contribution works and Rs. 10,42,694 on maintenance and repairs of open water-works under Sanitary Engineer's supervision.

The increase of work in the branch is illustrated by the following comparison of work done in 1914-15 and 1920-21:—

Name of works.	1914-15.	1920-21.
	Lakhs Rs.	Lakhs Rs.
Projects sanctioned	18·01	86·11
Projects submitted	34·54	209·33
Projects in hand	97·77	210·04
Expenditure on original works by Sanitary Engineer's staff ...	1·00	9·40
Expenditure on Water Works maintenance	6·80	10·42
Cost of Sanitary Engineer's Department	1·38	2·80
Fees realised	0·29	2·18
Fees due but not paid	...	1·56

It has been laid down as a *sine qua non* with this branch that establishment charges must be covered by fees. In order, therefore, that some continuity may exist in the entertainment of staff for this branch a programme of sanitary works spread over a period of six to seven years has been drawn out in collaboration with the local authorities. This programme comprehends drainage, water-supply, and electric supply works and aggregates over Rs. 3 crores in value.

Records of water supplied in these provinces for a period of the last seven years shows that an average increase in consumption of water of 23 per cent. has taken place which is equivalent to about 3½ per cent. per annum. A greater increase than this would have taken place but for the limited capacity of many of the stations, accidents causing stoppages, and coal shortage. The increase in future will probably be at a still greater rate owing to the rapid development of industries and drainage works under construction.

The increase in running costs over the same period is normal in the case of Benares, Cawnpore, Lucknow, and Agra but remarkably abnormal in the case of Allahabad.

Most of the water-supplies are being run at a heavy loss and there is a general reluctance on the part of boards to increase water rates and water-charges in order that running expenses may be covered.

Suggestions to such purpose are generally met by the naive response that the supplies are already inadequate and that the public will therefore not stand increased rates. Lucknow, Benares, and Naini Tal Boards have, however, agreed to increase water charges.

The cost of water to the various boards, as calculated in Appendix I, does not take into account numerous grants-in-aid afforded by Government. Had loans been given the cost of water in every case would be appreciably higher.

During the year two Diesel engine crank shafts failed—one at Agra Water-Works and the other at Allahabad Sewage Pumping Station, the causes, in all probability, being due to wear in the main bearings. A crank shaft is expensive to replace now-a-days and all the boards where Diesel engines are used have been recommended to purchase special micrometer gauges for regularly testing the adjustment of the bearings.

OPEN WATER-WORKS.

Periodical analysis of water supplied at the various open water-works shows that the supply was of uniformly good quality, except at Allahabad where the filters have been neglected, and at Muttra, on one or two occasions, where there is reason to think that workmen contaminated the well.

Agra.—Except for the accident noted above, the plant has been maintained in good running order, the mechanical filters have worked satisfactorily and a further consignment of spare parts has been received. The new Belliss sets have been erected and set to work so that the public in Agra will now experience an improved pressure in the supply. The Agra Water-Works is one of the most efficiently managed in the Province.

Allahabad.—In Allahabad both Karelabagh and Khusrubagh stations have not received the attention necessary, where a public supply is in question and the Board's attention has been drawn to the state of affairs on more than one occasion. Owing to the abnormal fall of the Jumna water level the unfiltered supply had to be maintained by temporary plant on the river bank. The scanty filtered supply was supplemented by pumping from the Thornhill Road and Daraganj Tube Wells, the Boring Division providing the necessary plant and staff.

On 19th August an air vessel on the suction of the Beam Engines burst and was replaced by a temporary arrangement. The coal stock was at times allowed to become exhausted and but for coal obtained on loan from local factories the water-supply would have been stopped.

Benares.—The condition of the old plant has been greatly improved and reflects credit on the staff managing the works. Minor repairs effecting economy were carried out departmentally resulting in a saving to the board. Reasonable precautions have been taken to maintain the plant pending the re-organization of the supply.

Cawnpore.—Some friction between members of the board's staff has been noticed, which is not conducive to the public interest. The plant has been fairly well maintained. At times the final filters were worked at rates higher than permissible owing to acute shortage. It is hoped that the board will lose no time in putting work in hand on the project for re-organizing the water-supply recently drawn out by the Consulting Engineer to the Improvement Trust. The board should make early arrangements for entertaining additional staff to pay more attention to waste prevention.

Lucknow.—The shortage of water here is also acute, specially in the Bandariabagh area, but the plant has been maintained in good order and sufficient spares have been provided to permit of the existing plant carrying on until the supply is re-organized.

Meerut.—The machinery at Bhola is as usual in fair order, and steps have been taken to maintain the water turbines until such time as the Tube Wells and Hydro-Electric Supply are completed. Water hammer is liable to take place in the long rising main during stress of demand. Shortage of supply is acute.

Naini Tal.—Steps have been taken to keep the engines and boilers in working order, pending the completion of the Hydro-Electric Supply.

As regards other open water-works, at Muttra the demand is rapidly increasing; at Jhansi and Mirzapur there is nothing particular to record; at Mussoorie the shortage of supply is becoming more marked each successive season.

ORIGINAL WORKS—WATER-WORKS.

Agra Water Supply Improvements.—This work has been completed. The new pumping plant has not yet been taken over from the manufacturers as satisfactory tests have not yet been run. The St. John's reservoir, although completed some time ago, is not put into regular use by the board. The high zone tank is filled with water for emergent use only, otherwise the supply is pumped direct into the distribution system. The public do not therefore benefit to the same extent by the increased pressure as was intended. This has been brought to the notice of the Chairman of the board.

Allahabad.—Thornhill Road and Mayo Hall pump chambers have been completed and motor-driven centrifugal pumps are being installed The engine house at Daragunj Tube Well has been completed. An oil engine and vertical spindle centrifugal pump are being installed.

Tube Wells.—Tube Wells at Maheshpur Uttaria, Meerut, and Ferozabad have not been tested owing to the railways not being able to deliver the testing plant.

All efforts to recover the casing pipes at Tundla Tube Well have proved unsuccessful; the well has been abandoned.

A tube well is being constructed at Bareilly for the Forest Department Wood Working Institute.

Magh Mela Water-Supply.—As in previous years, a temporary drinking water-supply for the Magh Mela for one million pilgrims was provided from the Daraganj Tube Well for a period of 2½ months. This was arranged by the Boring Division with a boiler and Worthington pump as the centrifugal pump and oil engine could not be got ready in time.

Hardwar Adh-Kumbh Mela.—A temporary water-supply was also satisfactorily provided at Hardwar by the Boring Division and the First Sanitary Division. The supply being given for six weeks. It is a pity that the Hardwar water-supply has not yet been put on a permanent basis.

The well at Gola Gokarannath was handed over to the District Board and tools and plant removed from the site.

Lucknow water-supply.—Geological trial borings on the banks of the river Goomti at Lucknow have been completed.

Thanks to the efforts of the Chairman, the Lucknow water supply project has been approved and orders for the generating transmission, pumping and filtration plant have already been placed.

Naini Tal Hydro-Electric Supply.—Orders for all the generating and pumping plant, together with the transmission and distribution and public lighting material, have been placed. The power station building and sub-stations and the pumping station buildings are well in hand.

A preliminary project for Benares has been presented to the board but nothing difinite has yet been decided concerning the financing of this scheme, nor have the Allahabad Board come to any decision concerning the financing of their water-supply.

The fair project for Jhansi water-supply has been presented to the Board who up to date have not intimated their intention to proceed with it.

The project for Aligarh Hydro-Electric Supply has been completed and presented to the board.

A survey and project is in hand for treating the Manikarnika ghat at Benares which is being damaged by the Ganges.

ORIGINAL WORKS—DRAINAGE AND DRAINAGE SCHEMES.

Allahabad Drainage Works.—The work at Kydganj has been completed and will shortly be handed over to the Municipal Board.

Agra.—The Board have not yet intimated any desire to proceed with their drainage, nor have they come to any conclusion as to how it is to be financed.

Moradabad.—Moradabad drainage work has almost been completed except for one or two short lengths, as property owners threatened damages and thereby delayed work.

Cawnpore.—The Permitghat sewage pumping station has been completed and handed over to the board.

Lucknow.—The work on the sewage pumping station near the paper mills bridge has progressed and is now above spring water level. Most of the plant has been received and efforts are being made to complete this pumping station as well as the farm within the shortest possible time but the work has been seriously delayed owing to strike and railway transit difficulties. The western intercepting sewer has also almost been completed.

This sewer, together with the sewage pumping station, constitutes the foundation of Lucknow drainage.

Muttra.—Work on the Holi darwaza sewer was started in October, 1920 and is proceeding satisfactorily. The complete new sewerage scheme for the whole town is being revised.

Dehra Dun.—Dehra Dun supplementary drainage work was finally completed. The latrines and pail dépôts were put into use and have been working satisfactorily.

The Arhat bazar drainage has been delayed by opposition from the Arhtees.

GENERAL REMARKS.

Exhortations to more vigorous measures for waste prevention in water-supplies have had disappointing results. No material improvement is possible unless the boards are determined to prosecute offenders.

The labour troubles and the wagon difficulty on railways have caused serious delay to almost every work in this branch. Several works have had to be stopped for want of coal and materials which the railways could not deliver and not without a certain loss to the public.

At all the water-works pumping stations the stocks of coal have become depleted and the coal situation is still a source of anxiety.

Proposals have been put before the various coal-consuming boards to appoint a Coal Supply Committee with a view to ensuring a regular supply of good quality coal at reasonable rates to all boards represented. Under existing arrangements the boards are in the hands of coal contractors and are supplied with most inferior fuel, without any proper means of redress. The boards have been presented with draft specifications and terms of contract for this purpose and several have already taken steps on the lines suggested.

The fall in the exchange value of the rupee has caused much work in revision of sanctioned estimates and the works at Naini Tal and Lucknow are considerably affected by the excesses thus caused.

The accession of the newly-joined specialist officers to this branch has already brought about a marked improvement in the quality and quantity of work turned out. The subordinate staff requires strengthening in view of the work ahead.

The concentration of all the division of this branch in a central office at Lucknow or Allahabad would make for greater efficiency and proposals have already been made to this end.

Sanitary Engineer has to thank the following officers for their efforts during the year :—

Mr. S. E. Platt,
Mr. J. N. Mittra,
Mr. K. Chattopadhya
and Mr. Raja Ram.

The following members of the staff have also to be commended for their zeal during the year :—

Babu Lajpat Rai,
Babu Balram Das Dhawan and
Babu J. N. Ghuttuck.

G. McC. HOEY,
Sanitary Engineer to Government,
United Provinces.

The 15*th May,* 1921.

APPENDIX

Statement of operations

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
Population.				
1. By census of 1921 in municipality	163,902	144,103	195,783	191,464
2. Ditto Cantonments ...	22,044	11,867	4,210	21,580
3. Number of inhabitants drawing their supply from mains.*	185,946	155,970	196,885	191,468
Consumption of water.				
4. During the year including cantonments in gallons.	1,385,131,000	1,148,206,000	2,343,753,000	2,127,550,000
5. Daily average, including cantonments, in gallons.	3,794,879	3,145,769	6,421,241	5,828,904
6. Maximum daily average in any month, in gallons.	3,877,981	3,678,021	6,792,258	7,019,572
7. Water used for irrigation and manufacturing purposes, in gallons.	146,559,000	211,969,000	34,456,000	302,159,844
8. Water used for domestic purposes in gallons.	1,238,572,000	936,237,000	2,309,297,000	1,825,390,156
9. Consumption per head for domestic purposes, in gallons.	18·25	16·44	32·13	26·12
10. Consumption per head for trade, in gallons.	2·16	3·72	·47	4·32
Total ...	20·41	20·16	32·60	30·44
11. Daily average for cantonments alone, in gallons.	290,450	278,079	2,203	46,620
12. Number of house connections during 1920-21.	263	69	219	303
13. Number of metered connections...	119	299	7 House meters 35 District ,,	53
Annual receipts and charges.				
14. Maintenance charges rupees ...	1,56,496	1,23,908	1,55,515	2,03,636
15. Cost per 1,000 gallons consumed annas.	1·807	1·727	1·661	1·531
16. Cost per 1,000 per 100 feet lift annas.	·959	·957	·615	·838
17. Cost of water per 1,000 gallons including interest, and sinking fund charges. Annas.	3·213	*1·727	1·883	2·010
Lift of pump.				
18. From river to settling tanks ...	46·00 feet	118·50 ft.	96·20 ft.	107·20 ft.
19. From filtered water pumps to town distribution.	142·40 ,,	61·92 ,,	76·32 ,,	75·26 ,,
Total lift ...	188·40 ,,	180·42 ,,	172·52 ,,	182·46 ,,
Income from water-works.				
20. Water rate recovered during the year. Rs.	1,19,695	1,58,048	1,76,359	1,57,810
21. Sale of water and other receipts Rs.	77,625	39,995	8,614	1,07,130
Total income Rs.	1,97,320	1,98,043	1,84,973	2,64,940

* Interest and S. F. charges not paid this year.

No. I.

during the year 1920-21.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
219,709	77,711	12,895	16,517	33,476	50,556	55,032	42,708
23,844	44,856	2,346	802	Nil	15,976	Nil	10,235
177,935	122,567	12,000	17,319	33,476	25,000	38,400	42,708
1,348,323,000	554,143,000	70,982,000	53,479,000	65,910,000†	50,722,751	159,764,000†	220,034,000†
3,694,035	1,518,200	194,471	146,517	180,575†	138,966	437,709	602,832
4,175,166	1,780,352	246,524	234,711	180,576	180,275	467,708	807,488
52,093,000	11,530,000	Nil	438,010	Nil	478,635	17,029,000	22,90,000
1,296,230,000	542,613,000	70,982,000	53,040,990	65,910,000	50,244,124	142,735,000	217,744,000
19·96	12·12	16·20	8·39	5·39	5·50	10·18	13·96
·80	·26	...	·069	...	·05	1·21	·14
20·76	12·38	16·20	8·45	5·39	5·55	11·39	14·10
352,740	7,73,450	1,128	3,663	Nil	17,848	Nil	Nil
5,134	33	356	256	16	16	116	145
281	34	357	230	14	4	506	15
1,83,386	42,376	36,724	80,219	7,265	15,383	7,657	30,069
2·176	1·223	8·278	24·00	1·76	4·85	·766	2·186
1·255	·945	·719	3·78	...	2·77	Nil	1·593
3·598	2·468	15·715	54·88	3·582	6·12	3·07	2·982
108·60 ft.	15·16 ft.	...	H. L. 1141·00 ft.	...	...	...	...
64·70 ft.	114·28 ft.	Main pump 1,700·00 ft.	L. L. 439·50 ft.	Gravity ...	174·60 ft.	Gravity ...	137·2 ft.
173·30 ft.	129.44 ft.	Auxiliary 600·00 ft.	L. L. 254·50 ft.	Supply ...	174·60 ft.	Supply ...	137·2 ft.
85,648	...	38,828	33,784	...	7,344	14,625	28,961
1,49,026	71,130	14,398	30,533	2,925	385	2,113	1,243
2,34,674	71,130	53,226	64,317	2,925	7,729	16,738	30,204

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† Excluding cantonment.

APPENDIX No. II.

Annual maintenance accounts of water-works during the year 1920-21.

Name of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
I.—Establishment—												
(a) Permanent establishment	29,974	31,849	46,929	45,659	47,833	18,300	8,425	14,696	3,405	2,007	4,081	15,916
(b) Office contingencies	1,364	304	1,275	395	757	5,590	756	358	51	166	178	221
(c) Rent	330	390	270	1,225	350	60	9	...	...	...	...	...
II.—Pumping—												
(a) Coal	43,820	51,062	60,381	80,586*	90,682	1,060	18,354‡	52,067	...	8,035	...	7,786§
(b) Oil and waste	7,572	11,921	9,824	9,480	6,264	790	5,640	876	...	500	...	...
(c) Other stores	9,511	3,754	8,341	13,098	7,118	4,557		371	...	57	...	482
III.—Intake—												
(a) Training river	...	41	...	680	...	...	...	...	...	...	...	...
(b) Cleaning channels and wells	7,888	...	...	52	...	50	...	...	...	...	...	...
IV.—Settling tanks and filters—												
(a) Cleaning settling tanks and wells	601	35	2,429	1,014	9,336	79	..	...	...	...	...	102
(b) Cleaning and renewing filter beds	5,468	1,520	1,783	10,535	23	2,069	...	...	...	...	...	...
(c) Purchase of sand	18,550	255	4,530	3,834	3,873	1,056	...	...	...	...	...	...
(d) Purchase of allumino feric	...	...	4,838	10,413	...	2,328	...	...	...	...	...	...
V.—Distribution—												
(a) Pipes and fittings	10,739	2,292	1,029	7,217	12,083	977	301	3,571	3,779	692	1,280	405
(b) Meters	1,822	71	...	4,512	822	...	1,506	465	...	60	...	618
(c) Stand post or Hydrants	...	...	...	...	...	...	...	...	...	...	1,720	338
VI.—Repairs—												
(a) To tanks	298	22	37	170	...	...	259	154	...	54	...	...
(b) To buildings and grounds	1,928	1,218	2,997	1,245	576	1,128	94	316	...	130	217	...
(c) To machinery	17,047	17,101	8,850	13,015	3,730	4,079	1,233	6,200	...	1,145	...	3,844
(d) To rising main	...	...	2,005	...	...	...	...	...	...	55	...	...
(e) To tools and plant	...	...	...	...	...	...	...	229	...	...	...	...
VII.—Water analyses	89	2,073	3	506	939	253	147	916	30	...	181	437
VIII.—Cost of water—												
Irrigation dues	...	...	...	...	...	...	...	...	...	2,482	...	...
Total	1,56,496	1,23,908	1,55,515	2,03,636	1,83,386	42,376	36,724	80,219	7,265	15,383	7,657	30,069
Interest and Sinking Fund charges	1,21,784	†	1,20,408	63,781	1,19 840	43,152	32,996	1,03,233	7,504	4,050	23,012	10,966
GRAND TOTAL	2,78,280	1,23,908	3,75,923	2,67,417	3,03,226	85,528	69,720	1,83,452	14,769	19,433	30,669	41,035

* Includes charge for electricity canal pumping station.
† Interest and S. F. charges not paid this year.
‡ Cost of energy.
§ Oil fuel.

APPENDIX No. III.

Statement showing initial capital cost of subsequent extensions and improvements incurred on water-works in the United Provinces to the end of 31*st March*, 1921.

Water-Works Stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extensions during the year.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	17,84,786	91,687	30,47,234
Allahabad	16,24,061	8,51,584	19,809	24,95,454
Benares	25,61,881	8,04,884	Nil.	33,66,765
Cawnpore	14,44,570	10,65,564	27,168	25,37,302
Lucknow	15,15,736	8,92,546	57,913	24,66,195
Meerut	7,51,710	54,078	1,310	8,07,098
Mussooree	4,79,754	2,12,871	22,770	7,15,395
Naini Tal	2,47,000	4,21,826	613	6,69,439
Dehra Dun	97,241	83,629	Nil.	1,80,870
Mirzapur	6,29,508	42,155	Nil.	6,71,663
Jhansi	96,556	61,521	Nil.	1,58,077
Muttra	5,17,288	7,134	13,228	5,37,650

APPENDIX No. IV.

Statement showing rate of filteration and results of water-works of the United Provinces, during the year 1920-21.

Municipalities.	Rate of filteration in gallons per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.		Mechanical filter samples.
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.	
Agra ...	38·00	22·00	31·27	6	...	6	109	23	7
Allahabad ...	50·00	12·15	32·94	3	...	3	738	258	...
Benares ...	62·50	12·50	39·15	4	1	5	440	37	...
Cawnpore ...	60·00	10·00	43·19	24	5	29	568	7	...
Lucknow ...	53·00	9·30	25·35	6	...	6	298	12	...
Meerut ...	40·50	25·00	33·50	6	1	7	241	28	...
Mussoorie ...	...	...	...	5	...	5	5	Nil.	...
Naini Tal ...	...	...	...	13	...	13	63	14	...
Muttra ...	...	...	...	8	7	15	27	10	...

APPENDI

Details of pumps filters, tanks, reservoirs, rising mains, etc.,

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
1. Consumption of water per capita in gallons per diem.	20·41	20·16	32·60	30·44
2. Number of inhabitants drawing their supply of water from the mains.	185,946	155,970	196,885	191,468
3. Water used for irrigation and manufacturing purposes.	146,559,000	211,969,000	34,456,000	302,159,844
4. Power of pumps per hour in gallons at river.	2 Horizontal pumps each 28 H. P.	2 Beam Engines 102 H. P. each.	2 Horizontal Engines each 120 H. P.	2 Engines each 86 H. P.
	Designed for 84,000	Designed for 126,000	Designed for 252,000	Designed for 187,500
	Maximum 96,000	Maximum 154,961	Maximum 234,388	Maximum 187,500
	Average 78,000 1 Worthington low duty pump. Designed for 120,000 Maximum 132,000 Average 102,000 2. Diesel Engines 55 H. P. Designed for 180,000 Maximum 228,000 Average 192,000	Averege 114,862 1 Triple Expansion Engine 120 H. P. Designed for 191,000 Maximum 192,000 Average 156,250	Average 176,423 1 Worthington high duty pumping engine 235 H. P. Designed for 500,000 Average 382,710	Average 154,467 2 Engine 100 H. P. Designed for 217,500 Maximum 235,000 Average 208,580
5. Power of pumps per hour in gallons at filter.	2. Beam Engines each 100 H. P.	2. Beam Engines each of 135 H. P.	4. Beam engines each of 120 H. P.	Two engines each 80 H. P.
	Designed for 192,000	Designed for 223,300	Designed for 450,000	Designed for 187,500
	Maximum 200,000	Maximum 265,000	each set (2 engines)	Maximum 187,500
	Average 180,000 1. High duty Worthington 150 H. P. Designed for 150,000 Maximum 156,000 Average 144,000 Two Belliss and Morcom designed for 150,000 gallons each.	Average 188,453	Maximum 357,458 Average 336,562	Average 171,180 One engine, Designed for 283,140 Maximum 338,238 Average 288,470
6. Number of rising mains...	2	2	2	2
7. Length of rising main ...	2·5 and 1·75 miles respectively.	3·8 miles	Old rising main 4,727′ New „ „ 4,100′	1·32 miles
8. Size of rising mains ...	28″ and 18″	20″	Both 24″	Each 20″ dia ...
9. Number of settling tanks	5	3	3	3
10. Size of settling tanks ...	Each 260′ × 151′	Each 280′ × 180′	403·5′ × 252·5′ × 15′	Each 243·5 × 243·5 × 12·5.
11. Capacity of settling tanks in gallons.	2,200,000	1 and 3=4,400,620 2=4,455,626	1 and 3=6,436,120 2=6,508,927	Each 5,923,664 ...

No. V.

in the water-works of the United Provinces for 1920-21.

Lucknow.	Meerut.	Mussooree.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
20·76	12·38	16·20	8·45	5·39	5·55	11·39	14·10
177,935	122,567	12,000	17,319	33,476	25,000	38,400	42,708
52,093,000	115,30,000	Nil.	438,010	Nil.	478,635	17,029,000	22,90,000
2 Engines of 130 H. P. each.	One engine of 26 H. P.	*(a)* Main pump designed for 10,800.	...	...	2 Compound piston pumps each capable of discharging 13,200 gallons per hour.		
Designed for 187,500. Maximum 188,237. Average 178,517.	Two turbines 90 H. P. Designed for 72,000 Maximum 61,985. Average 37,037.	Average 10,900. ... *(b)* Auxiliary pumps. Designed for 4,800. Average 5,000.	Lake station Designed for 14,355. Three engines each 31 H. P. No. 1 Engine plunger 5″ 13,104 gallons. No. 2 Engine 3¼″ 5,160 gallons. No. 3 Engine 3¼″ 5,160.	... ...		...	2 Diesel of 100 H. P. crude oil engines and dynamos. 2 Motor-driven centrifugal pumps to deliver 60,000 gallons *per hour.* Actual discharge 84,000 gallons per hour.
3 Engines of 110 H. P.	Second lift pump driven by same power.	*(a)* Main pump (motor driven two designed for 150 H. P.) each.	...	...		...	
Designed for 187,500. Maximum not known. Average 178,000.	Designed for 66,000. Maximum 50,611. Average 30,327.	*(b)* Auxiliary pump (motor driven) two designed for 23 H. P. each.	...				
1	1	2	5	...	5	1 Gravitation main.	1
3·5 miles...	15″ main = 38,292′. 13″ main = 8,550′.	Murray springs 6,000 feet. John Mackinnon springs 1,400′.	Ayarpatta ·93 miles. Tonnochy ·66 miles. Pilgrim ·34 miles. Inter Cheena ·49 miles. Inter Ayarpatta ·25 miles.		... 1=3·65 miles 2=0·70 miles 3=1·6 miles 4=30·40 ft. 5=50·40 ft.	5·73 miles	4,817 feet.
20″	13″ and 15″	Murray springs 5″. John Mackinnon springs 3½″.	4″, 3½″, 3″ 4″, 5″.	2½″ and 3″ main pipe-line.	9″, 6″, 6″, 4″, 3″.	12″ diameter	12″
3	3	...	...				
250′ × 200′ × 13′·6′	100′ × 60′ × 11′	...	...				
each 4,000,000	528,000 each.	...	...				

Details of pumps, filters, tanks, reservoirs, rising mains, etc.

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
12. Number of filters ...	7+1 mechanical filter.	6	8	7
13. Size of filters ...	200′×100′	200′×100′	200′×100′×6′—4½″	200′×100′
14. Number of C. W. reservoirs	3	2	2	2
15. Size of C. W. reservoirs...	103′×105′× 10′	Each 160′×103·3′ × 12′	178⅓′ × 148⅓′×12′	Each 135′ × 106⅔′ ×12′ deep.
16. Capacity of C. W. reservoirs in gallons.	676,000 each	1,240,000 each ...	1,854,068	Each 953,300
17. Number of service reservoirs or stand pipes.	3	1	1	2
18. Size of service reservoirs	1 66′ dia. × 11⅓′ deep. 2 20′ dia. × 50′ deep.	60′ dia. ×11′ deep	60′ dia. ×15′ deep	Balancing tanks 50′—6″ high×36′ dia. 50′—6″ high×40′ dia.
19. Capacity of service reservoirs.	1 438,000 2 200,000 each	194,000 gallons	265,000	Holds 318,087 and 392,700 gallons respectively.
20. Number of public stand-posts.	One-tap stand-post ... 197 Two-tap stand-post of ¾″ size ... 79 Four-tap stand-post each ¾″ size ... 42	One-tap stand-post ...144 Two-tap stand-posts .. 59 Four tap stand-posts ... 70 Waste-not cocks 13 Push cocks ... 13 Wall boxes ... 7 Bib cocks of ¾″ 6	One-tap stand-post ...245 Two-tap stand-posts ...108 Four-tap stand-posts ... 80	One-tap stand-post ... 59 Two-tap stand-posts ... 52 Four-tap stand-posts ... 90 Tap stand-posts 55 Bathing platforms 5

No. V.

in the water-works of the United Provinces for 1920-21—(concluded).

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
7	4	...	1 chlorine plant.	...	...	...	...
200′ × 100′	150′ × 100′	...	...	...	...	...	...
2	1	5	7	...	...	...	...
Each 105′ × 107′ × 12′ deep.	48′×52½′× 7′ deep.	2 × (40′ × 25′ × 8′) 1 × (30′× 20′× 8′). 1 × (80′ × 24′ × 6′). 1 of 79′—4 × 38′ × 11.	45′ × 40′ × 6′ at W. W. station.	...	...	...	...
798,500′ each.	110,600	2 of 50,000 each 1 of 30,000 1 of 72,00 1 of 204,000	67,500 ...	...	...	...	...
1	2	18 Iron Service Tanks. 1 10′ × 10′ × 4′.	82 Small service reservoirs and 6 large service tanks.	25	1	1	2
66′ × 12′	Each 25′ × 34′.	9 8′ × 4′ × 4′. 5. 4′ × 4′ × 4′.	Small service tanks. 32 of 3′ × 3′ 29 of 2′—8″ × 3′, 1 of 4′ × 3′. 3 of 4′ × 5′ and 17 square tanks 6′ × 8′ × 4″. Large Service tanks:— 1 of 36′ × 15′ × 9·5′. 2 of 22·5′ × 13·33′. 1 of 29·5′ × 15′ × 9·5′. 1 of 20′ × 10′, 1 of 18′ × 10′.	Service reservoirs holding 193,225 gallons.	40′ × 15′ × 8′.	200′ × 75′ × 14′.	32′ dia. and 20′ high each.
250,000	100,000 gallons.	1 of 2,500 gallons, 9 of 800 gallons. 5 of 400 gallons.	Total capacity of small reservoirs 32,200 gallons. Total capacity of large service reservoirs 185,874 gallons.	...	30,000 gallons.	208,446 ...	100,000 gallons each.
One-tap stand-post 102 Two-tap stand-posts 228	One-tap stand-post of ¾″ 41 Two-tap stand-post of ¾″ 90 Wall fountains 3 Taps of ½″ 4.	... One-tap stand-post 1 Two-tap stand-posts 32.	Stand-posts 27.	15 tanks of G. I. sheets, different sizes holding 2,290 gallons. 4 stand-posts with one brass cock and 17 stand-posts with 2 brass cocks.	Stand-posts with two-taps each 10. Iron tanks with 6 taps each 7. Service tank with 50 taps 1.	One-tap stand-post 34. Two-tap stand-posts 27. Four-tap stand-posts 9. Hydrants 111 Wash out 7.	One-tap stand-post 36. Two-tap stand-posts 55. Standpipes Do. one-tap 40. Do. two-tap 5.

APPENDIX No. VI.

Detailed statement of the expenditure incurred on works of sanitary nature executed under supervision of the Sanitary Engineer during the year 1920 21.

No.	Name of places.	Water-works original and special repairs.	Water-works maintenance.	Drainage works.	Other works.	Total.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	Agra	1,05,365	1,56,496	9,950	3,213	2,75,024
2	Allahabad ...	94,778	1,23,908	81,077	...	2,99,763
3	Benares ...	10,726	1,55,575	...	...	1,66,301
4	Cawnpore ...	...	2,03,636	23,200	...	2,26,836
5	Lucknow ...	26,000	1,83,386	2,26,336	...	4,35,722
6	Meerut ...	6,626	42,376	...	...	49,002
7	Mussooree ...	...	36,724	*Nil.*	...	36,724
8	Naini Tal ...	2,09,533	80,219	...	...	2,89,752
9	Dehra Dun ...	...	7,265	29,148	...	36,413
10	Muttra ...	7,428	30,069	21,000	...	58,497
11	Mirzapur ...	...	7,657	...	...	7,657
12	Jhansi	...	15,383	...	...	15,383
13	Khurja... ...	...	...	4,013	...	4,013
14	Saharanpur ...	...	...	4,453	3,547	8,000
15	Moradabad ...	...	...	8,814	...	8,814
16	Haldwani ...	21,572	...	...	...	21,572
17	Deoband ...	...	...	2,033	...	2,033
18	Sardhana ...	...	...	2,828	...	2,828
19	Gola Gokaran Nath	137	...	...	...	137
20	Farrukhabad ...	932	...	...	...	932
21	Unao	2,890	...	...	...	2,890
22	Ramnagar ...	9,363	...	...	...	9,363
23	Hardwar ...	8,729	...	...	...	8,729
24	Ferozabad ...	5,903	...	...	...	5,903
25	Pukhrayan ...	868	...	...	...	868
26	Tundla ...	575	...	...	...	575
27	Bareilly ...	597	...	...	...	597
28	Maheshpur Utaria ...	2,806	...	...	...	2,806
29	Fatehgarh ...	6,261	...	...	...	6,261
			...			
	Total ...	5,21,089	10,42,694	4,12,852	6,760	19,83,395

APPENDIX No. VII.

Comparative statement of working expenses of water-works schemes in the United Provinces for the year 1920-21.

Number.	Name of water-works.	Class of work, gravitation or pumping.	Fuel consumed.	Fuel consumption per 1,000 feet gallons.	Price of fuel per ton.	Total lift including friction.	Percentage of charges for—			Average consumption in gallons per head per day	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet gallons for pumping schemes.	Cost of maintenance per head of population.	Cost of fuel per 1,000 feet gallons	Income per head of population.	Remarks.
							Establishment.	Fuel	Other charges							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17
			Tons. cwt.	lbs	Rs. a. p.						As.	As.	As.	As.	As.	
1	Agra ...	Pumping ...	2,501 15	*·02108	17 5 0	188·40′	19·15	27·63	53·17	20·41	1·807	·00959	13·46	·00264	16·97	*Includes 84 tons 9 cwt. fuel oil.
2	Allahabad	Ditto ...	4,392 8	·0474	11 10 0	180.42′	25·70	41·20	33·10	20·16	1·727	·00957	12·71	·0039	20·51	
3	Benares ...	Ditto ...	5,420 3	·03002	11 2 3	172·52′	30·17	38·83	31·00	32·60	1·0616	·00615	12·44	·00238	14·79	
4	Cawnpore	Ditto ...	5,962 8	·0344	13 8 3	182·46′	22·42	†39·57	38·01	30·44	1·531	·00830	15·29	·00332	19·89	†Includes electrical charges for pumping canal.
5	Lucknow...	Ditto ...	7,112 6	·06819	12 12 0	173·30′	26·08	49·44	24.48	20.76	2·176	·01255	12·04	·00621	15·41	
6	Meerut ...	Turbines worked by water power.	83 18	...	...	129·44′	43·18	2·50	54·32	12·38	1·223	·00945	5·53	...	9·28	
7	Mussooree	Pumping ...	...	...	...	Main Pumps—1,700·00′ Auxiliary Pumps 600·00′	22·94	†49·98	27·08	16·20	8·278	·00719	38·55	†·0036	55·87	† Cost of energy.
8	Naini Tal	Pumping and gravitation.	1,407 4	·0928	37 0 0 and §36 0 0	High Level 1,141·00′ Inter Level 439·50′ Low Level 254·50′	18·32	64·91	16·77	8·45	24·00	·0378	74·11	·0245	59·42	§ Wood 100 maunds.
9	Dehra Dun	Gravitation...	...	...	...	...	46·86	...	53.14	5·39	1·76	...	3·47	...	1·39	
10	Jhansi ...	Pumping ...	535 13	·1354	15 0 0	174·60′	13·04	52·23	34·73	5·55	4·85	·02776	3·69	·0145	1·859	
11	Mirzapur...	Gravitation...	...	...	...	...	53·29	...	46·71	11·39	·766	...	2·22	...	4·86	
12	Muttra ...	Pumping ...	64 17	‡·00481	‡120 0 0	137·20′	52·93	‡25·89	21·18	14·10	2·186	·01593	9·088	·00412	9·12	‡Fuel oil.

APPENDIX F.

Statement showing details of capital cost, income and expenditure for water works in the United Provinces for the year 1920-21.

Serial number.	Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussooree.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
1	Description of plant	Oil Engine and Steam Power.	Steam Power.	Steam Power.	Steam Power.	Steam Power.	Water and Steam Power.	Hydro-Electric Power.	Steam Power and Gravity.	Gravitation.	Steam Power.	Gravitation.	Oil Engine.
2	Inhabitants drawing their supply in thousand ...	186	156	197	191	178	122	12	17	33	25	38	43
3	Original cost of scheme in lakhs	11·71	16·24	25·62	14·45	15·16	7·52	4·80	2·47	·97	·97	6·30	5·17
4	Quantity supplied during year in million gallons ...	1,385	1,148	2,344	2,127	1,348	554	71	53	66	51	160	220
5	Maximum daily average during one month in 1,000 gallons.	3,878	3,678	6,792	7,020	4,175	1,780	247	235	181	180	468	807
6	Average daily supply in thousand gallons for year ...	3,795	3,146	6,421	5,828	3,694	1,518	194	146	181	139	433	603
7	Maximum supply per head per day during one month	20·85	23·58	34·49	36·66	23·46	14·52	20·54	13·55	5·39	7·21	12·18	18·90
8	Average supply per head per day	20·41	20·16	32·60	30·44	20·76	12·38	16·20	8·45	5·39	5·55	11·39	12·18
9	Total lift in feet	188·40	180.42	172·52	182·46	173·30	129·44	1,700·00 600·00	1,141·00 439·50 254·50	...	174·60	...	137·20
10	Quantity supplied during year in million foot gallons.	260,959	207,159	404,344	388,193	233,664	71,728	81,629	33,951	...	8,856	...	30,189
11	Fuel in lb. per million foot gallon 5 P. H. P. hrs. approx.	21·08	47·40	30·02	54·40	68·19	...	...	92·80	...	135·40	...	4·81*
12	Cost of fuel per ton in rupees	17·5·0	11·10·0	11·2·3	13·8·3	12·12·0	...	...	37·0·0 Wood 36·0·0†	...	15·0·0	...	120·0·0*
13	Cost of fuel per million foot gallon in annas ...	2·64	3·94	2·38	3·32	6·21	·24	3·60‡	24·53	...	14·50	...	4·13
14	Cost of establishment per million foot gallon in annas	1·84	2·46	1·85	1·88	3·27	4·08	1·65	6·93	...	3·62	...	8·43
15	Cost of other charges per million foot gallon in annas	5·11	3·17	1·92	3·18	3·07	5·13	1·94	6·34	...	9·64	...	3·37
16	Cost of working charges per million foot gallon excluding Int. and S. F. in annas.	9·59	9·57	6·15	8·38	12·55	9·45	7·19	37·80	..	27·76	...	15·93
17	Cost of maintenance charges only per 1,000 gallons in annas.	1·807	1,727	1·0616	1·5314	2·176	1·223	8·278	24·00	1·76	4·85	·766	2·186
18	Cost per 1,000 gallons including interest and S. F. actual in annas.	3·213	1,727§	1·883	2·010	3·598	2·468	15·715	54·88	3·582	6·12	3·07	2·982
19	Interest and sinking fund actual in thousand rupees	121·78	Nil§	120·41	63·78	119·84	43·15	32·99	103·23	7·50	4·05	23·01	10·97
20	Working charges in thousand rupees	156·50	123·91	155·51	203·64	183·39	42·38	36·72	80·20	7·26	15·38	7·66	30·07
21	Total Income in thousand rupees	197·32	198·04	184·97	264·90	234·67	71·13	53·23	64·31	2·92	7·73	16·74	30·20
22	Profit or loss on working expenses, in thousand rupees.	+40·82	+74·13	+29·46	+61·26	+51·28	+28·75	+16·51	—15·89	—4·34	—7·65	+9·08	+·13
23	Profit or loss on working expenses and actual interest and Sinking Fund in thousand rupees.	—80·96	+74·13§	—90·95	—2·52	—68·56	—14·40	—16·48	—119·12	—11·84	—11·70	—13·93	—10·84

* Oil Fuel. † Per 100 maunds. ‡ Cost of energy. § Interest and S. F. charges (about Rs. 123 thousand) not paid this year.

APPENDIX No. VIII.

A.—List of projects finally sanctioned during the year 1920-21.

	Rs.
Agra : Supply of clear water to the Taj Mahal fountains	26,860
Do. Remodelling of settling tanks	38,061
Do. Shahganj drainage	55,876
Do. (Sabzimundi) storm water sewer	6,287
Do. Sanitary fittings to circuit house	11,534
Allahabad : Water-supply re-organisation	17,60,925
Ditto Karelabagh reinforced concrete tunnels for engines A & B	25,174
Ditto Water-supply to Magh Mela	10,497
Bareilly : Government Central Wood Working Institute tube well	11,872
Deoband : Drain diversion (revised)	15,636
Dehra Dun : Drainage improvement (revised original scheme)	85,854
Fatehgarh : Central Jail tube well	7,167
Farrukhabad : Tube well	13,886
Fyzabad : Water-supply	9,93,890
Gola Gokaran Nath : Water-supply improvement	1,13,988
Hardwar : Temporary water-supply for Adh-Kumbh Mela	11,495
Do. Temporary water-supply for Adh-Kumbh Mela (supplementary)	3,118
Lucknow : Bandariabagh water-supply	16,382
Do. Extension of water-supply in Clyde Road	3,291
Do. Western intercepting sewer	2,79,747
Do. Settling tank baffle wall	5,284
Meerut : Hydro-electric supply	14,44,909
Moradabad : Drainage improvements (revised)	62,361
Ditto Flushing scheme	1,98,600
Muttra : Pail dépôts, Holi Darwaza and Colonelganj drainage	90,070
Do. Balancing tank	13,940
Mussoorie : Drainage of Happy Valley section	70,530
Naini Tal : Hydro-electric supply	11,39,639
Saharanpur : Drainage	5,88,278
Ditto Water-supply	13,29,566
Maheshpur : Uteria : Tube well (revised)	3,587
Meerut : Tube well	13,554
Nimsar : Drainage	45,828
Do. Road improvement	7,829
Pukhrayan : Ginning factory tube well	8,706
Ramnagar : Water-supply (revised)	28,592
Sardhana : Drainage	31,468
Sikandara : Kanch Mahal water-supply	37,194
Total	86,11,469

B.—List of projects submitted but not sanctioned during the year 1920-21.

Agra : Thomason and Lady Lyall Hospitals drainage	58,632
Aligarh : Hydro-electric supply	11,40,232
Do. Water-supply	11,06,288
Allahabad : Unfiltered water supply : Reservioir at Daraganj	19,598
Benares : Waters-upply re-organization (preliminary proposals)	21,90,662
Do. Flushing scheme	92,212
Cawnpore : Drainage, Part IV, Rs. 6,56,715 Ditto ditto V, Rs. 1,98,844	8,55,559
Chandausi : Sewage farm (preliminary proposals)	12,450
Debai : Drainage (rough proposals)	41,679
Carried over	55,17,342

	Rs.
Brought forward	55,17,342
Dehra Dun : Arhat bazar drainage (revised)	27,440
Ditto Sewage farm extension	8,715
Ditto Water-supply (preliminary proposals)	9,35,670
Jhansi : Water-supply	20,33,952
Kosi : Drainage sewage outfall extension	11,678
Lucknow : Trans-Gomti sewer	15,13,643
Do. River training	21,904
Do. Drainage scheme	74,54,317
Muttra : Drainage scheme (revised)	19,31,649
Do. Drainage and pail dépôts, etc. (revised)	1,33,632
Do. and Brindaban : Electric supply (preliminary proposals)	13,04,750
Nagina : Drainage scheme	13,357
Estimate for the purchase of cement gun outfit	25,000
Total	2,09,33,049

C.—List of projects under preparation.

Agra : Sewage farm	2,25,000
Allahabad : Water-supply re-organization	25,00,000
Ditto Civil Lines drainage	7,00,000
Ditto Unfiltered water supply, revised scheme	2,36,000
Ditto Naini sewage farm	2,36,000
Beldeo Drainage, Muttra	3,92,675
Balrampur : Drainage	7,00,000
Banda : District jail water-supply improvement	13,000
Benares : Water-supply from tube well	1,42,303
Do. Electric and water-supply	45,00,000
Brindaban : Water-supply	4,00,000
Ditto Drainage	6,00,000
Bijnor : Drainage	5,00,000
Cawnpore : Drainage project, Part VI	2,50,000
Ditto Sewage farm	4,00,000
Chandausi : Flushing scheme	1,50,000
Dehra Dun : Water-supply	10,00,000
Farrukhabad : Water-supply	4,50,000
Ditto Drainage	1,50,000
Fatehpur Sikri : Water-supply (preliminary proposals)	2,000
Ghaziabad : Drainage	27,922
Gobardhan : Tube well	25,000
Kanauj : Drainage	2,25,853
Kaimganj : Drainage	1,50,000
Khurja : Drainage scheme (revised)	35,328
Lucknow : Water supply re-organization	35,00,000
Do. Sewage Farm and pumping station (revised)	6,20,983
Do. Bandariabagh drainage	3,10,810
Do. Trans-Gomti storm water	3,50,000
Nanauta : (Saharanpur) Railway bridge trial boring	2,500
Pilibhit : Drainage	10,00,000
Ramnagar : Storm drainage	9,345
Saharanpur : Hydro-electric supply	8,00,000
Ujhani : Drainage (revised)	4,00,000
Total	2,10,04,719

1919/20-29

III
21,
(a)

TWENTY-FIFTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31st MARCH, 1920.

ALLAHABAD:
Printed by the Superintendent, Government Press, United Provinces.
1920.

The Chairman, Municipal Board,
Naini Tal.

R. N.

H.C.

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16/9/20

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Errata slip to the 25th annual report of the Sanitary Engineer to Government, United Provinces, for the year ending the 31st March, 1920.

Name of stations.	Number of appendix.	Number of items.	For— B	Read
Naini Tal	I	6	7,107,075	197,002
Agra	I	17	3·67	3·04
Allahabad	I	17	2·83	3·16
Benares	I	17	1·80	1·91
Cawnpore	I	17	2·15	1·78
Lucknow	I	17	3·16	3·02
Meerut	I	17	2·43	2·37
Naini Tal	I	17	2·31	1·90
Dehra Dun	I	17	Rs. 3·56	As. 3·24
Jhansi	I	17	5·27	4·61
Muttra	I	17	3·32	2·89

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ALLAHABAD:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS, UNITED PROVINCES
1920.

Twenty-fifth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending the 31st March, 1920.

Establishment.—The post of Sanitary Engineer was held by Mr. A. C. Verrieres, C.I.E., from 1st April to 17th September, 1919 and by Mr. G. McC. Hoey from 18th September, 1919 to the close of the year.

The following officers were employed in the Sanitary department under the Sanitary Engineer:—

(1) Mr. G. McC. Hoey, Executive Engineer, held charge of the First Sanitary Division, Saharanpur, from 1st April, to 29th September, 1919; Mr. Ishaq Khan, Assistant Engineer, from the 30th September, to 26th November, 1919 and Mr. C. F. Hunter, Executive Engineer, from 27th November, 1919 to the close of the year.

(2) Mr. S. E. Platt, Executive Engineer, held charge of the Second Sanitary Division, Allahabad, throughout the year. He also worked as Personal Assistant to the Sanitary Engineer in addition to his other duties up to 17th September, 1919, on which date he made over charge to Mr. J. N. Mittra, Assistant Engineer, who worked as Personal Assistant till 14th January, 1920, on which date he made over charge to Mr. E. W. Clarke, Executive Engineer, who was posted to this department on the 15th October, 1919.

(3) Mr. A. S. Knox, Executive Engineer, held charge of the III Sanitary Division and Well-Boring Operations Division, from 1st April, 1919 to 24th January, 1920, when he resigned his appointment and handed over charge of the III Sanitary Division to Mr. K. Chattopadhya, Assistant Engineer. On the same date Mr. J. N. Mittra took over charge of the Well-Boring Operations Division which he held till the close of the year.

Mr. E. W. Beveridge, temporary Executive Engineer, returned from military duty but unfortunately died on the 24th November, 1919 before taking over charge. By his death this department lost an experienced and able officer.

In addition to the above, 14 Assistant Engineers, one Upper Subordinate, nine Temporary Upper Subordinates, 55 Lower Subordinates, two Mechanical Upper Subordinates, 46 Draftsmen, the necessary clerical staff, Accountants, and Works establishment were employed in the department.

The following stations were visited by the Sanitary Engineer during the year:—

Agra, Allahabad, Benares, Cawnpore, Lucknow, Bareilly, Meerut, Mussoorie, Naini Tal, Mirzapur, Jhansi, Muttra, Hardwar, Roorkee, Chunar, Gorakhpur, Fyzabad, and Saharanpur.

Expenditure.—The sum of Rs. 6,59,055 was spent on original sanitary contribution works and Rs. 9,35,282 on maintenance and repairs of open water works under Sanitary Engineer's supervision; the total expenditure exclusive of the cost of preparation of projects under the supervision of the Sanitary Engineer was Rs. 15,94,837 as shown in appendix VI of this report.

Projects amounting to Rs. 16,44,231 were finally sanctioned during the year and schemes to the value of Rs. 75,08,406 were completed and submitted for sanction, including preliminary estimates to the value of Rs. 45,09,054. Work in hand on projects during the year amounted to Rs. 1,62,80,446 approximately.

Open water-works.—Weekly analyses of water supplied at the various open water-works show that the supply was of uniformly good quality except at Allahabad where the percentage of bacteriological counts over 100 per C. C. was high and the attention of the Superintendent concerned has been called to this.

Agra.—The plant has been maintained in good running order. All the spare parts ordered since 1914 arrived during the year under report and this has greatly facilitated the work of renewing and repairing the engines.

The Diesel engines at the unfiltered station worked satisfactorily throughout the year and certain minor repairs were done locally in the workshop but as the consignment of important parts has now arrived necessary repairs will be done next cold weather. All seven filters were re-made with a 6″ layer of new Chambal sand. The mechanical filters were satisfactorily used throughout the year as final filters.

Allahabad.—The work of overhauling the plant at Karellābagh has been entrusted to Messrs. Worthington Simpson, who have completed 'B' engine and now have 'A' engine in hand. The board's staff have proved unable to maintain in first-class order 'C' engine which was overhauled by the firm last year.

The cracks in 'C' gallery have opened further, but there is no sign of immediate trouble.

At Khusroobagh the filters have been made with unsuitable sand and the earliest opportunity should be seized to re-make them with proper sand.

Benares.—The pumping plant at the riverside station was, as stated in my last report, handed over to Messrs. Worthington Simpson to maintain, but unfortunately very little repair work has been done owing to non-receipt of the spare parts. For the 'C' and 'D' engines new cast-steel helical spur wheels have been received and are being fitted. When all spare parts have been received the plant will be in good condition but it will be heavily overtaxed to meet existing demand.

The condition of the engines at the filtered station is not satisfactory, as all the pump barrels are badly worn and want either re-boring and providing with new buckets or renewing. Petty repairs have been done but the plant is unable to cope with the ever increasing demand. The Board is to be congratulated that considering the present state of the machinery there has been no accident of a serious nature at either of the stations during the year.

Cawnpore.—Both the old engines were opened out and practically all worn parts renewed. The opportunity for such an overhaul was obtained by installing temporary plant. The filter plant has given entire satisfaction.

The demand now exceeds the capacity of the plant and it is essential that the question of additional plant be investigated without delay.

Lucknow.—Considering the present demand the plant generally has been well maintained. The old vertical engine at Gaughat failed twice during the year but in October last an extended suction was provided, which, it is hoped, will obviate further breakdowns.

Meerut.—The machinery at Bhola is in fair order with the exception of turbine no. 1, which requires repairs. The filters and settling tanks worked satisfactorily. The demand far exceeds the capacity of the plant and the question of augmenting the supply should receive immediate attention.

Mussoorie.—The pumping plant gave satisfaction throughout the year, but is inadequate for the existing demand not to mention the extensions in view. A preliminary project for the construction of a third pumping station at Bhilaru has been prepared and forwarded to the Board of Public Health for administrative sanction. Work on the construction of a new reservoir has been commenced.

Naini Tal.—The engines and boilers are in fair working order; the repairs recommended by inspecting officers from time to time have been carried out but have not received the necessary attention to ensure first-class work.

The springs have been in use all the year and have saved much coal. All the collecting reservoirs and high level springs have been cleaned out.

The construction of the Endcliffe tank near the Malli Tal latrine for flushing purposes is in hand.

As regards other open water works, at Jhansi and Mirzapur there is nothing particular to record. At Muttra the tube wells continue to give satisfaction and the demand for water is increasing at a marked rate. The engines and pumps are working satisfactorily. A watertight manhole door has been fitted in the central sump which now removes the danger of the sump being flooded.

The very small supplies at Jhansi and Dehra Dun call for early steps on the part of the boards concerned.

ORIGINAL WORKS—WATER WORKS.

Agra.—St. John's Reservoir was practically completed during the year, the sheeting of the roof and boundary wall being all that remained.

Allahabad.—The sinking of the tube wells at Mayo Hall and Thornhill Road has been completed. The construction of the engine house has been taken up. The pumping plant is expected to arrive shortly.

As in previous years, a temporary pumping plant for the Magh Mela was erected and water was supplied to the pilgrims and inhabitants of the locality for about two and a half months from the Daragunj tube well.

The Polo Ground well has been abandoned as the yield was not sufficient to justify installing pumps.

Tube wells.—Tube wells at Maheshpur Utaria for the Government Rosin factory, at Bareilly cantonment, at Ferozabad, at Cawnpore for the Military department, and for the East Indian Railway, at Fatehgarh for the Central Jail and at Aligarh were completed during the year.

No satisfactory water-bearing strata were met with at the tube well sunk at Tundla and the 12″ casing pipes parted during lifting operations. This has necessitated special arrangements being made to extract these pipes.

The masonry cylinder has been completed at the Meerut tube well and satisfactory water-bearing strata found within a 212 feet bore.

Test-pumping was carried out at Gola Gokaran Nath and the discharge was found 12,000 gallons per hour, showing that this well has deteriorated, having lain idle for a couple of years.

Tests at Benares gave 22,200 and 19,200 gallons per hour respectively from the two wells there.

Water-supply projects.—Preliminary projects for re-organisation of their water-supplies have been completed and forwarded to the respective boards:—

Lucknow	....	Rs. 27 lakhs.
Allahabad	....	Rs. 18 „

Both boards have accepted the schemes and submitted their proposals for financing them to Government for approval.

Similar proposals for Benares are in hand. The long-delayed Jhansi water-supply project is now rapidly nearing completion so also is the Hydro-Electric Supply for Aligarh.

With the exception of Agra and Muttra water works there is not a pumped water-supply in the provinces which is not seriously over-taxed by a demand which is rapidly increasing and in the cases of Lucknow, Allahabad, Benares, Cawnpore, and Naini Tal the position is indeed precarious.

ORIGINAL WORKS—DRAINAGE AND DRAINAGE SCHEMES.

Allahabad drainage works.—Kydgunj drainage has been in progress. Expenditure to date is Rs. 1,28,978 from the grant of two lakhs given by Government. A scheme for the extension of the Naini Sullage farm was prepared and forwarded to the municipal board for approval.

The machinery at the Jumna pumping station is in fair working order though certain repairs are urgently needed and the attention of the board has been drawn to this matter. The second Aster set has been installed.

Agra.—The drainage scheme for the municipality has been administratively sanctioned by the Board of Public Health and that of cantonments was forwarded to the Military Authorities for their approval. The existing Sullage farm has continued to work satisfactorily and an income of Rs. 8,000, equal to that of the last year, had been realized. A scheme for a new sewage farm is also being prepared.

The work on the Shahganj drainage and borrow pit-filling project has been held up due to delay in the acquisition of the necessary land.

Moradabad.—Construction of the work of Moradabad drainage improvements was given to Messrs. Ford and Macdonald on a lump sum contract and is being carried out by them.

The drain-flushing scheme has had to be revised owing to the rise in prices of material. It has been approved by the municipal board and submitted to Government for final sanction.

Cawnpore.—Schemes for Cawnpore Drainage, Part III and Permitghat Sewage Pumping Station have been finally sanctioned by Government and the project for Parts IV, V, and VI are under consideration of the municipal board. A scheme for extension of the sewage farm is also being considered.

At Permitghat Sewage Pumping Station a temporary plant was erected by this department which afforded opportunity for both the old engines to be thoroughly overhauled. The work on this station is being carried out by the Executive Engineer, III Sanitary Division.

Lucknow.—At Lucknow the construction of a sewage pumping station and sewage farm has been started by the Executive Engineer, II Sanitary Division, and efforts are being made to get the pumping station finished before the monsoon.

The detailed survey of the Trans-Gumti area was nearly finished and that of the Cis-Gumti area, prepared by the municipal staff, is being checked.

The revised Lucknow sewerage project was prepared by Messrs. Lane Brown and Hewlett and will be shortly submitted to the municipal board. This project comprehends the following areas:—Sarkata Nala, Maulviganj, Hussainganj, Pata Nala, Ghasiari Mundi, and Narhi Area.

Almora.—A sum of Rs. 9,705 was spent on the Almora drainage work. The work is still in progress.

Muttra.—The scheme for the pail dépôts and Holi Darwaza sewerage amounting to Rs. 90,070 was finally sanctioned by Government and arrangements are being made for its construction.

A comprehensive scheme for sewerage is also nearing completion. The proposals to carry the sewage across the river Jumna over the railway bridge to a farm on the left bank is under consideration.

Dehra Dun.—The storage reservoir, pail dépôts, and water-flushed latrines have been completed and handed over to the Board. The sewage farm has proved too small for the sewage discharged and the Board have been urged to take early steps to extend it. Some surface work in the city is still in hand.

A sum of Rs. 4,715 was spent on the Arhat Bazar improvement, which is still in progress.

Khurja drainage works.—About one half of the work had been done at a cost of Rs. 6,465; the work is in progress.

Mussoorie.—Landour Bazar drainage work was completed, the expenditure during the year being Rs. 2,728.

General remarks.—Some difficulty has been experienced during this year by frequent long delays in obtaining information from some municipal boards and this renders it almost impossible for Sanitary Engineer to keep his work up to date.

Some boards appear to resent Sanitary Engineer's requests for information and returns, as unjustifiable interference.

Lala Shiva Charan Lal, B.A., LL.B. Chairman, municipal board, Allahabad, rightly understands Sanitary Engineer's position as technical adviser and does not hesitate to ask advice on professional matters: this attitude is much appreciated.

The reluctance of all boards to offer sufficient salary renders it impossible for them to secure properly qualified Municipal Engineers who would be capable of designing and constructing important sanitary works: this matter deserves the serious consideration of the boards concerned.

During the year the outstanding difficulty experienced by the Sanitary Engineer has been due to the paucity of his trained staff; this branch has lost during the year two Executive Engineers, Mr. Knox, who resigned and Mr. Beveridge, who died. Two of the more experienced Assistant Engineers have also resigned, whilst it has proved very difficult in some divisions to retain the services of trained subordinates on the present rates of pay.

It is understood that a Mechanical Engineer of Superintending Engineer's rank will shortly be appointed to relieve Sanitary Engineer of the supervision of pumping plant, and that five Assistant Sanitary Engineers will also be appointed during the forthcoming year. This it is hoped will enable Sanitary Engineer and his superior staff to devote the necessary detailed attention to the works in hand.

The staff generally deserves great credit for the way in which they have carried on work during the past year.

The amount of work in hand has frequently necessitated the attendance of the staff on holidays and by this means only, long delays have been prevented.

Sanitary Engineer's special thanks are due to Mr. S. E. Platt for his able assistance and cheerful acceptance of more than his proper share of work on the resignation of Mr. Knox; Messrs. Muhammad Ishaq Khan, J. N. Mittra and K. Chattopadhya deserve special mention for their steady work during the year.

The following subordinates also deserve special mention for good work:—

Mr. A. K. Nandi, Upper Subordinate.
Babu Lajpat Rai, temporary Upper Subordinate.
Babu Khan Chand, temporary Upper Subordinate
B. Balram Das Dhawan, Mechanical Upper Subordinate.
B. Budh Parkash, Camp Clerk.

G. McC. HOEY,
Sanitary Engineer to Government,
United Provinces.

NAINI TAL:
Dated the 4th June, 1920.

APPENDIX

Statement of opera

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
Population.				
1. By Census of 1911, in Municipality	163,935	159,701	199,868	173,981
2. „ „ Cantonments	21,514	11,996	3,936	21,517
3. Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868	173,981
Consumption of water.				
4. During the year including cantonments, in gallons.	1,311,740,900	1,450,011,519	2,106,945,631	2,121,318,923
5. Daily average, including cantonments, in gallons.	3,583,992	3,961,780	5,756,682	5,795,953*
6. Maximum daily average in any one month, in gallons.	4,093,343	5,749,128	8,510,356	6,902,923
7. Water used for irrigation and manufacturing purposes, in gallons.	167,923,667	230,558,796	38,056,000	520,409,392
8. Water used for domestic purposes, in gallons.	1,143,817,233	1,219,452,723	2,068,889,631	1,600,909,531
9. Consumption per head for domestic purposes, in gallons.	16·85	19·40	28·28	25·14
10. Consumption per head for trade, in gallons.	2·47	3·66	·52	8·17
Total ...	19·32	23·06	28·80	33·31
11. Daily average for cantonments alone	275,194	237,679	2,228	Nil
12. Number of house connections during 1919-20.	130	41	257	274
13. Number of metered connections	123	311	5. House meters 35. District „	63
Annual receipts and charges.				
14. Maintenance charges Rupees ...	129,565	152,245	130,867	186,931
15. Cost per 1,000 gallons consumed...	1·58 as.	1·67 as.	·993 as.	1·41 as.
16. „ „ per 100 feet lift	·82 „	·98 „	·606 „	·79 „
17. Cost of water per 1,000 gallons, including interest and sinking fund charges.	3·94 ~~3·67~~ „	3·16 ~~2·98~~ „	1·91 ~~1·80~~ „	1·78 ~~2·15~~ „
Lift of pump.				
18. From river to settling tanks ...	46 feet	94·00 ft.	91·24 ft.	105·00 ft.
19. From filtered water pumps to town distribution.	147 „	76·00 „	72·60 „	71·80 „
Total lift ...	193·0 „	170·00 „	163·84	176·80
Income from water-works.				
20. Water rate recovered during the year Rs.	116,841	151,460	168,009	160,120
21. Sale of water and other receipts Rs.	78,068	47,340	9,514	13,242
Total income Rs.	194,909	198,800	1,77,523	173,362

* Excluding cantonment

No. I.

ons during the year 1919-20.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
240,016	76,755	11,985	16,788	30,301	58,236	55,304	54,332
19,782	39,876	2,511	1,239	Nil	11,970	Nil	3,851
177,935	116,631	11,000	18,027	30,301	25,000	38,400	54,332
1,418,926,000	547,996,772	82,634,027	38,323,102	65,910,240	47,128,070	169,480,722	211,303,500
3,876,847	1,497,259	225,776	104,708	*180,082	128,765	*463,062	*577,332
4,440,758	1,866,659	255,562	197002 ~~1,107,075~~	180,082	171,595	635,715	787,500
91,603,800	10,495,910	Nil	325,343	Nil	674,160	23,437,294	Nil
1,327,322,200	537,500,856	82,634,027	37,997,759	65,910,240	46,453,910	146,043,428	211,303,500
20·38	12·59	20·52	5·75	5·94	5·07	10·39	10·62
1·39	·25	Nil	0·04	Nil	·073	1·66	Nil
21·77	12·84	20·52	5·79	5·94	5·143	12·05	10·62
348,219	629,344	671	3,630	Nil	1,427	Nil	Nil
204	2	350	250	16	14	113	174
302	32	351	221	14	4	299	2
150,609	38,108	37,751	49,765	5,859	12,413	8,278	32,891
1·69 as.	1·11 as.	7·30 as.	Rs. 1·29	1·42 as.	4·21 as	0·78 as.	2·49 as,
·95 ,,	0·81 ,,	·634 ,,	,, ·19	...	2·43 ,,	...	1·82 ,,
3·02 ~~3·16~~ ,,	2·37 ~~3·48~~ ,,	Rs. 0·86	1·90 ,, ~~2·31~~	Rs. 3·44 ~~R. 2·50~~	4·61 ~~[illegible]~~ ,,	2·95 ,,	2·39 ~~[illegible]~~
111·8 ft.	15·16 ft.	Main pump 1,700′	Tounochy 1,160′ Ayarpatta 1,093′	Gravity supply.	...	Gravitation	...
65·4 ft.	121·47 ft.	Auxiliary 600′	Inter Cheena 450′ Inter Ayar-patta. 400′	...	173·11	Scheme	136·83
177·2 ft.	136·63 ft.	...	Pilgrim 240′	...	173·11	...	136·83
81,785	...	37,999	30,888	...	7,132	...	25,211
113,409	70,108	11,035	19,987	2,319	1,033	18,939	77
195,105	70,108	49,034	50,875	2,319	8,165	18,939	25,288

APPENDIX No. II.

Annual maintenance accounts of water-works in the United Provinces during the year 1919-20.

Name of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
	Rs.	Rs.	Rs.	Rs	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. *Establishment.*												
(*a*) Permanent establishment.	25,312	24,154	42,705	41,311	37,299	14,544	7,504	11,270	3,313	2,237	2,890	12,014
(*b*) Office contingencies.	1,315	201	1,478	1,484	637	5,516	401	335	29	1,894	108	363
(*c*) Rent ...	348	1,520	270	...	350	60	4	...	...	...	...	...
2. *Pumping.*												
(*a*) Coal ...	32,412	60,558	48,229	77,262	68,192	1,571	19,014*	25,178	...	5,215	...	2,936†
(*b*) Oil and waste	7,190	14,885	12,431	12,629	6,651	1,626	3,857	181	...	489	...	28
(*c*) Other stores	9,221	4,769	5,618	6,892	13,183	4,253	1,934	1,244	...	166	...	898
3. *Intake.*												
(*a*) Training river.	...	...	...	664	750	...	...	...	...	...	...	...
(*b*) Cleaning channels and wells.	4,740	61	...	13	500	44	...	...	...	...	...	...
4. *Settling tanks and filters.*												
(*a*) Cleaning settling tanks.	2,531	...	2,483	3,587	...	66	...	...	...	...	...	...
(*b*) Cleaning and renewing filter beds	3,405	2,184	1,025	6,534	1,187	1,579	...	171	...	...	...	...
(*c*) Purchase of sand.	12,950	641	2,816	6,352	7,266	913	...	...	...	...	...	...
(*d*) Purchase of allu mino-ferric.	...	...	3,941	6,588	1,344	2,700	...	...	...	...	...	...
5. *Distribution.*												
(*a*) Pipes and fittings.	3,170	2,999	3,064	5,523	6,168	1,188	1,287	4,976	2,497	1,479	1,831	2,685
(*b*) Meters ...	4,610	275	...	5,031	727	...	76	517	...	641	1,072	380
6. *Repairs.*—												
(*a*) To tanks ...	278	25	281	860	...	434	451	236	...	143	...	...
(*b*) To buildings and grounds.	4,240	1,636	1,846	2,500	625	929	127	744	...	148	2,327	8,660
(*c*) To machinery.	17,728	35,922	6,986	9,217	5,231	2,458	3,008	4,289	...	...	...	4,451
(*d*) To rising main.	...	...	2,680	...	...	...	...	...	...	...	...	...
7. *Water analysis.*	115	2,415	14	484	499	227	93	624	20	1	50	476
Total ...	1,29,565	1,52,245	1,30,867	1,86,931	1,50,609	38,108	37,751	49,765	5,859	12,413	8,278	32,891

* Cost of energy.

† Fuel oil.

APPENDIX No. III.

Statement showing initial capital cost of subsequent extensions and improvements incurred on water-works in the United Provinces to the end of 31*st March*, 1920.

Water-works stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extensions during 1919-20.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	17,26,167	58,619	29,55,547
Allahabad	16,24,061	8,28,150	23,434	24,75,645
Benares	25,61,881	7,68,652	36,232	33,66,765
Cawnpore	14,44,570	10,28,474	37,090	25,10 134
Lucknow	15,15,736	8,77,752	14,794	24,08,282
Meerut	7,51,710	52,158	1,929	8,05,797
Mussoorie	4,79,754	1,88,846	24,025	6,92,625
Naini Tal	2,47,000	4,20,577	1,249	6,68,826
Dehra Dun	97,241	81,274	2,355	1,80,870
Mirzapur	6,29,508	42,155	Nil.	6,71,663
Jhansi	96,556	61,521	Nil.	1,58,077
Muttra	5,17,288	6,303	831	5,24,422

APPENDIX No. IV.

Statement showing rate of filtration and results of water-works of the United Provinces during the year 1919-20.

Municipalities.	Rate of filtration in gallons per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.		Mechanical filter samples.
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.	
Agra ...	50·00	18·00	30·54	...	...	...	...	...	...
Allahabad ...	51·25	12·50	34·90	...	...	...	911	66	...
Benares ...	50·00	12·50	33·45	10	..	10	735	60	...
Cawnpore ...	50·00	10·00	38·91	4	...	4	804	4	...
Lucknow ...	46·80	12·50	28·22	5	...	5	360	15	...
Meerut ...	48·00	21·00	36·40	2	...	2	184	4	...
Mussoorie ...	...	...	...	...	...	...	...	...	...
Naini Tal ...	...	...	...	...	...	...	...	...	...
Muttra ...	...	...	...	14	...	14	37	7	...

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising mains, etc.,

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
1. Consumption of water per capita in gallons per diem.	19·32	23·06	28·80	33·31
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868	173,981
3. Water used for irrigation and manufacturing purposes.	167,923,667	230,558,796	38,056,000	520,409,392
4. Power of pumps per hour in gallons at river.	2 Horizontal pumps each 28 H. P. Designed for 84,000 Maximum 96,000 Average 78,000 1 Worthington low duty pump. Designed for 120,000 Maximum 132,000 Average 102,000 2. Diesel Engines 55 H. P. Designed for 180,000 Maximum 228,000 Average 192,000	2 Beam Engines 102 H. P. each. Designed for 126,000 Maximum 154,961 Average 114,862 1 Triple Expansion Engine 120 H. P. Designed for 192,000 Maximum 192,000 Average 156,250	2 Horizontal Engines each 120 H. P. Designed for 252,000 Maximum 234,388 Average 176,423 1 Worthington high duty pumping engine 235 H. P. Designed for 500,000 Average 332,710	2 Engines each 86 H. P. Designed for 187,500 Maximum 187,500 Average 153,467 1 Engine 100 H. P. Designed for 217,500 Maximum 235,000 Average 208,580
5. Power of pumps per hour in gallons at filter.	2. Beam Engines each 100 H. P. Designed for 192,000 Maximum 200,000 Average 180,000 1. High duty Worthington 130 H. P. Designed for 150,000 Maximum 156,000 Average 144,000	2. Beam engines each 135 H. P. Designed for 223,300 Maximum 265,000 Average 188,453	4. Beam engines each of 820 H. P. Designed for 450,000 each set (2 engines) Maximum 357,458 Average 336,562	Two engines each 80 H. P. Designed for 187,500 Maximum 187,500 Average 171,180 One engine. Designed for 283,140 Maximum 338,238 Average 288,470
6. Number of rising mains	2	2	2	2
7. Length of rising main ...	2·5 and 1·75 miles respectively.	3·8 miles	Old rising main 4,727′ New „ „ 4,100′	1·32 miles ...
8. Size of rising mains ...	18″ and 18″	20″	Both 24″	Each 20″ dia.
9. Number of settling tanks	5	3	3	3
10. Size of settling tanks ...	Each 266′ × 151′	Each 280′ × 180′	403·5′ × 252·5′ × 15′	Each 355′ × 255′ ...
11. Capacity of settling tanks in gallons.	2,200,000	1 and 3 = 4,400,320 2 = 4,455,626	1 and 3 = 6,436,120 2 = 6,508,927	Each 3,000,000 ...

No. V.

in the water-works of the United Provinces for 1919-20.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
21·77	12·84	20·52	5·79	5·04	5·14	12·05	10·62
177,935	116,631	11,000	18,027	30,301	25,000	38,400	54,332
91,603,800	10,495,916	Nil	325,343	...	674,160	23,437,224	Nil.
2 Engines of 130 H. P. each. Designed for 187,500. Maximum 188,237. Average 178,517...	One engine of 26 H. P. Two turbines 90 H. P. Designed for 72,000. Maximum 61,985. Average 37,037.	(a) Main pump designed for 10,800. Average 10,900. ... (b) Auxiliary pumps. Designed for 4,800. Average 5,000.	... Lake station Designed for 14,355. Three engines each 31 H. P. No. 1 Engine. plunger 5" 13,104 gallons. No. 2 Engine 3¼" 5,160 gallons. No. 3 Engine 3¼" 5,160.	... ...	2 Compound piston pumps each capable of discharging 13,200 gallons per hour.		2 Diesel of 100 H. P. crude oil engines and dynamos. 2 Motor-driven centrifugal pumps to deliver 60,000 gallons per hour. Actual discharge 90,000 gallons per hour.
3 Engines of 110 H. P.	Second lift pump driven by same power.	(a) Main pump (motor driven two designed for 150 H. P.) each.	...	...			
Designed for 187,500. Maximum not known Average 178,000.	Designed for 66,000. Maximum 50,611. Average 30,327.	(b) Auxiliary pump (motor driven) two designed for 23 H. P. each.	...				
1	1	2	5	...	5	1 Gravitation main.	1
3·5 miles...	15" main = 38,292'. 13" main = 8,550'.	Murray springs 6,000 feet. John Mackinnon springs 1,400'.	Ayarpatta ·93 miles. Tonnochy ·66 miles. Pilgrim ·34 miles. Inter Cheena ·40 miles. Inter Ayarpatta ·25 miles.		... 1=3·65 miles 2=0·70 miles 3=1·6 miles 4=30·40 ft. 5=50·40 ft.	5·78 miles	4,817 feet.
20"	13" and 15"	Murray springs 5". John Mackinnon springs 3¼"	4", 3½", 3" 4", 5".	2½" and 3" main pipe-line.	9",6" 6",4",3",	12" diameter	12"
3	3	...	... ...				
250'×200'×13'6" each 4,000,000	100'×60'×11' 528,000 each.	...	...				

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising mains, etc.,

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
12. Number of filters ...	7+1 mechanical filter.	6	8	7
13. Size of filters ...	200′×100′	200′×100′	200′×100′×6′—4½″	200′×100′
14. Number of C.W. reservoirs	3	2	2	2
15. Size of C. W. reservoirs	103′× 105′ × 10′	Each 160′×103·3′ × 12′	178⅓′ ×148⅓′ ×12′	Each 135′ ×106⅔′ ×12′ deep.
16. Capacity of C. W. reservoirs in gallons.	676,000 each	1,240,000 gallons each.	1,854,068	Each 953,300 gallons.
17. Number of service reservoirs or stand pipes.	3	1	1	2
18. Size of service reservoirs	1 66′ dia. × 11⅓′ deep. 2 20′ dia. × 50′ deep.	60′ dia.×11′ deep	60′ dia. ×15′ deep	Balancing tanks 50′—6″ high×36′ dia. 50′—6″ high× 40′ dia.
19. Capacity of service reservoirs.	1 438,000 2 200,000 each	194,000 gallons	265,000	Holds 318,087 and 392,700 gallons respectively.
20. Number of public stand-posts.	Four-tap stand-post each ¾″ size ... 42 Two-tap stand-posts of ¾″ size ... 78 One-tap stand-post ... 192	One-tap stand-post ... 144 Two-tap stand-posts ... 59 Four-tap stand-posts ... 70 Waste-not cocks 13 Push cocks ... 13 Wall boxes ... 7 Bib cocks of ¾″ 6	One-tap stand-post ... 245 Two-tap stand-posts ... 108 Four-tap stand-posts ... 80	Four-tap stand-posts ... 90 Two-tap stand-posts ... 51 One-tap stand-post ... 65 Tap stand-posts 48 Bathing platforms 5

NO. V.

in the water-works of the United Provinces for 1919-20—(concluded).

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
7	4	...	1 chlorine plant.	...	...	...	
200′×100′	150′×100′	...	...	...	...	...	
2	1	4	7	...	...	...	
Each 105′×107′×12′ deep.	48′×52½′×7′ deep.	2 × (40′×25′×8′) 1 × (30′×20′×8′). 1 × (80′×24′×6′).	45′×40′×6′ at W. W. station.	...	...	...	...
798,500 gallons each.	110,600	2 of 50,000 gallons each 1 of 30,000 gallons. 1 of 72,000 gallons.	67,500	...	...	...	
1	2	18 Iron Service Tanks.	32 Small service reservoirs and 6 large service tanks.	25	1	1	2
66′×12′	Each 25′×34′.	1 10′×10′×4′. 10 8′×4′×4′. 5. 4′×4′×4′.	Small service tanks, 32 of 3′×3′ 29 of 2′—8″×3′, 1 of 4′ × 3′ 3 of 4′×5′ and 17 square tanks 6′×8′×4″ Large Service tanks :— 1 of 36′×15′×9·5′. 2 of 22·5′×13·33′. 1 of 29·5′×15′×9·5′. 1 of 20′×10′, 1 of 18′×10′.	Service reservoirs holding 192,225 gallons.	40′×15′×8′.	200′×75′×14′.	32′ dia. and 20′ high each.
250,000	100,000 gallons.	1 of 2,500 gallons. 4 of 1,600 gallons. 10 of 800 gallons. 5 of 400 gallons.	Total capacity of small reservoirs 32,200 gallons. Total capacity of large service reservoirs 185,874 gallons.	...	30,000 gallons.	208,446 ...	100,000 gallons each.
One-tap standpost 102 Two-tap standposts 228	One-tap standpost of ¾″ 41 Two-tap standpost of ½″ 90 Wall-fountains 8 Taps of ½″ 4	Two-tap standposts 32.	Stand-posts 27.	15 tanks of C.I. sheets, different sizes holding 2,280 gallons; 13 standposts with 2 brass cocks and 4 standposts with one brass cock.	Service tank with 50 taps 1. Iron tanks with 6 taps each 7. Standposts with two taps each 10.	One-tap standpost 37. Two-tap standposts 27 Four-tap standposts 7. Hydrants 11 Wash out 7	Tow-tap standposts 57. One-tap standpost 37. Standpipes two tap 2 Do. one tap 27.

APPENDIX NO. VI.

Detailed statement of the expenditure incurred on works of sanitary nature executed under supervision of the Sanitary Engineer during the year 1919-20.

No.	Names of places.	Water-works (original and special repairs).	Water-works maintenance.	Drainage works.	Other works.	Total.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	Agra	58,619	1,29,565	14,616	160	2,02,960
2	Allahabad ...	37,465	1,52,245	1,19,788	...	3,09,498
3	Benares ...	37,502	1,30,867	...	...	1,68,369
4	Cawnpore ...	38,801	1,86,931	9,272	93,265	3,28,269
5	Lucknow ...	14,794	1,50,609	65,607	12,339	2,43,349
6	Meerut ...	6,257	38,108	...	...	44,365
7	Mussoorie ...	24,025	37,751	8,405	2,728	72,909
8	Naini Tal ...	1,249	49,765	...	...	51,014
9	Dehra Dun ...	2,355	5,859	30,200	...	38,414
10	Jhansi	...	12,413	...	...	12,413
11	Mirzapur ...	...	8,278	...	...	8,278
12	Muttra... ...	831	32,891	3,450	...	37,172
13	Almora ...	25,000	...	9,705	...	34,705
14	Aligarh ...	3,873	...	...	...	3,873
15	Khurja... ...	...	...	6,465	...	6,465
16	Ramnagar ...	4,404	...	...	...	4,404
17	Haldwani ...	13,965	...	...	...	13,965
18	Saharanpur ...	...	...	1,286	...	1,286
19	Unao ...	1,066	...	...	...	1,066
20	Gola Gokaran Nath	932	...	...	...	932
21	Ferozabad ...	2,855	...	...	...	2,855
22	Tundla ...	1,876	...	...	...	1,876
23	Etawah ...	1,926	...	...	...	1,926
24	Fyzabad ...	2,380	...	...	...	2,880
25	Shahjahanpur ...	872	...	...	...	872
26	Bareilly ...	722	...	...	...	722
	Total ...	2,81,769	9,85,282	2,68,794	1,08,492	15,94,337

APPENDIX No. VII.

Comparative statement of working expenses of water-works schemes in the United Provinces for the year 1919-20.

Number.	Name of water-works.	Class of work, gravitation or pumping.	Coal consumption per 1,000 feet gallons.	Price of coal per ton.	Total lift, including friction.	Percentage of charges for— Establishment.	Percentage of charges for— Coal.	Percentage of charges for— Other charges.	Average consumption in gallons per head per day.	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet gallons for pumping schemes.	Cost of maintenance per head of population.	Cost of coal per 1,000 feet gallons.	Income per head of population.	Remarks
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			lbs.	Rs. a. p.						As.	As.	As.	As.	As.	
1	Agra ...	Pumping	·0197	14 8 9	193·00′	19·58	25·01	55·46	19·32	1·58	·0082	11·18	·00204	16·81	
2	Allahabad ...	"	·0426	12 15 0	170·00′	15·86	39·77	44·37	23·06	1·67	·0098	14·87	·00393	18·52	
3	Benares ...	"	·02549	10 15 4	163·84′	32·63	33·03	34·34	28·80	·993	·00606	10·27	·002003	13·93	
4	Cawnpore ...	"	·0381	12 1 0	176·8′	22·09	41·33	36·58	33·31	1·41	·0079	15·25	·00329	14·18	
5	Lucknow ...	"	·0552	11 0 0	177·2′	24·76	45·27	29·97	21·77	1·69	·0095	9·27	·00433	12·02	
6	Meerut ...	Hydro-turbine pumps.	...	...	136·63′	38·17	4·12	57·71	12·84	1·11	·0081	5·22	...	9·61	
7	Mussoorie ...	Pumping ...	...	...	Main Pumps—1,700′ Auxiliary 600′	19·87	*50·36	29·77	20·52	7·31	·00634	41·66	...	54·12	*Cost of energy.
8	Naini Tal ...	Pumping and gravitation.	·04162	37 0 0 Wood at Rs. 30 per 100 maunds.	Tonnochy 1,160′ Ayarpatta 1,093′ Inter Cheena 450′ Inter Ayarpatta 400′ Pilgrim 240′	22·64	50·59	26·77	5·79	20·64	·0304	44·16	·011	45·15	
9	Dehra Dun ...	Gravitation	...	...	...	56·54	...	43·46	5·94	1·42	...	3·08	...	1·22	
10	Jhansi ...	Pumping ...	·0979	14 9 9	173·11 feet	18·02	42·01	39·97	5·14	4·21	·0243	2·82	·01022	1·86	
11	Mirzapur ...	Gravitation	...	...	...	34·91	...	65·09	12·05	·78	...	2·39	...	5·47	
12	Muttra ...	Pumping	†·00252	†90 0 0	136·83 feet	36·52	†8·92	54·56	10·62	2·49	·0182	9·04	†·00162	6·95	†Fuel oil.

APPENDIX NO. VIII.

A.—List of projects finally sanctioned during the year 1919-20.

	Rs.
Allahabad Magh mela water-supply	5,632
Allahabad Kydgunj drainage (amended)	3,03,216
Aligarh tube-wells (test pumping)	3,852
Cawnpore drainage scheme, Part III	2,79,370
Cawnpore permit bazar pumping station	64,726
Cawnpore outfall sewer extension	1,31,458
Dehra Dun Arhat bazar drainage	18,638
Dehra Dun water flush latrines and hydrants	1,664
Dehra Dun outfall sewer extension	9,665
Deoband drain diversion	11,505
Etawah tube-well (revised)	21,694
Fatehgarh central jail tube-well	4,367
Gola Gokaran Nath tube-well (test pumping) ...	2,005
Haldwani water-supply (revised)	1,10,445
Khurja drainage	18,212
Lucknow sewage pumping station and sullage farm ..	6,34,833
Maheshpur (Bareilly) sawmills tube-wells	4,481
Mussoorie, additions and alterations to drain and latrines in the Landour bazar	6,354
Saharanpur, Pandhobi nala lining	7,200
Tundla, East Indian Railway tube-well	2,024
Unao, tube-well (test pumping)	2,890
Total ...	16,44,231

B.—List of projects submitted but not sanctioned during the year 1919-20.

	Rs.
Agra, extension of 3" distribution main along Stand Road	2,239
Agra, cantonment drainage	7,42,363
Agra, Circuit House water closets	3,628
Agra, Shahganj drainage (revised)	55,876
Allahabad, Karellabagh temporary bridge	5,181
Allahabad, Karellabagh permanent bridge	9,478
Allahabad, water-supply reorganization (preliminary proposals)	17,98,721
Allahabad, Naini Sullage Farm	86,497
Dehra Dun, drainage revised supplementary scheme ...	61,260
Dehra Dun drainage revised original scheme	85,854
Fyzabad drainage (revision)	67,846
Hapur flushing and water-supply scheme (preliminary proposals)	11,599
Jhansi storm water drains	17,155
Kosi water-supply	1,37,316
Kaimganj drainage	17,986
Lucknow water-supply reorganization (preliminary proposals)	26,98,734
Meerut tube-well, no. 2	14,260
Muttra water-works superintendent's quarters, additions and alterations	8,478
Moradabad flushing scheme	1,98,600
Carried over	60,22,911

	Rs.
Brought forward ...	60,23,011
Moradabad drainage improvement (revised)	63,255
Muttra, pail dépôts and Holi Darwaza sewer	90,070
Naini Tal, hydro-electric scheme	12,81,843
Nagina drainage improvement (revised)	10,990
Ramnagar water-supply	39,237
Total ...	75,08,406

Excluding land Co
[illegible]
Rs 11,39,639 [illegible]
finally sanctio
(vide G.O. 5050/11
d/10 May 1920 [illegible]
[illegible]

C.—*List of projects under preparation during the year* 1919-20.

	Rs.
Agra Mechanical filters, preliminary proposals... ...	1,08,653
Agra sullage farm	80,000
Agra Taj Mahal fountains water-supply	25,416
Allahabad Khusroobagh tube-well, fixing electrically driven pump at—	5,700
Allahabad unfiltered water-supply, well houses, revision of estimate and design	1,63,522
Aligarh Water-supply	10,00,000
Aligarh Hydro-Electric supply	10,00,000
Balrampore drainage	10,00,000
Benares water-supply-reorganization	19,00,000
Brindaban water-supply (preliminary proposals) ...	2,50,000
Budaun flushing scheme	60,000
Cawnpore sullage farm	6,50,000
Chandausi kaithalgate outfall estimate	13,000
Deoband drainage diverson (revision)	16,000
Dehra Dun water-supply improvements (preliminary proposals)	1,50,000
Farrukhabad water-supply	3,[illegible]0,000
Furrukhabad drainage	1,00,000
Fyzabad water-supply (revision)	8,81,000
Fyzabad tube-well (additional)	21,466
Gola Gokaran Nath sanitation (revision)	107,000
Gorakhpur drainage	15,00,000
Jhansi water-supply	20,00,000
Kanauj water-supply	2,25,853
Kosi drainage	8,000
Lucknow sewage pumping station and farm (revision) ...	7,00,000
Lucknow trans-Gumti drainage	6,00,000
Lucknow Gaughat river training	1,00,000
Muttra sewage scheme	19,31,640
Muzaffarnagar drain flushing (preliminary proposals) ...	99,687
Nagina drainage (preliminary proposals)	84,500
Nimsar roads and drainage (revision)	40,000
Rampur (district Saharanpur) drainage	9,000
Shahjahanpur drainage	12,00,000
Total ...	1,62,80,446

TWENTY-FOURTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31st MARCH, 1919.

ALLAHABAD:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS, UNITED PROVINCES.
1919.

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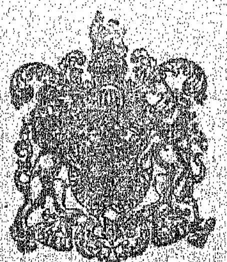

ALLAHABAD:
Printed by the Superintendent, Government Press, United Provinces.
1919.

Twenty-fourth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March, 1919.

Establishment.—The post of the Sanitary Engineer was held by Mr. C. H. West from 1st April, 1918, to 2nd September, 1918, and by Mr. A. C. Verrieres from 3rd September to the close of the year.

The following officers were employed in the Sanitary department under the Sanitary Engineer:—

(1) Mr. G. McC. Hoey, Executive Engineer, held charge of the First Sanitary Division, Saharanpur.

(2) Mr. S. E. Platt, Executive Engineer, held charge of the Second Sanitary division, Allahabad. He also worked as Personal Assistant to Sanitary Engineer in addition to his other duties.

(3) Mr. A. S. Knox, Executive Engineer, held charge of the Third Sanitary division, Cawnpore. During his absence on leave for six weeks Mr. K. Chattopadhya, Assistant Engineer, carried on the work of the division.

(4) Mr. E. W. Beveridge, Temporary Executive Engineer, held charge of the Well Boring Operations division until he was transferred to military duty in August, 1918. Mr. Knox then took over charge of the Boring division in addition to the Third Sanitary division. During the latter's absence on leave for six weeks Mr. J. N. Mittra, Assistant Engineer, carried on the work of the Boring division.

In addition to the above, eight Assistant Engineers, one Upper Subordinate, five temporary Upper Subordinates, 28 Lower Subordinates, 30 draftsmen, and the necessary clerical staff, accountants, and work establishment were employed in the department on various works.

Prior to 1st December, 1918, the province was divided for departmental purposes into one division (the First Sanitary division) and two unofficial circles ~~excluding Well Boring Operations division~~ but on that date Government sanctioned the formation of the Second and Third Sanitary divisions.

The following stations were visited by the Sanitary Engineer and his Assistants during the year:—

Agra, Allahabad, Benares, Cawnpore, Lucknow, Meerut, Mussoorie, Naini Tal, Dehra Dun, Jhansi, Muttra, Saharanpur, Bareilly, Ramnagar, Budaun, Balrampur, Shahjahanpur, Haldwani, Deoband, Almora, Mahoba, Gorakhpur, Muktesar, Patti, Sandila, Nagina, Ujhani, Azamgarh, Saidpur, and Hardwar and accompanied by Mr. Platt, the Sanitary Engineer, visited Calcutta to inspect the sanitary works there.

Expenditure.—The sum of Rs. 6,70,747 was spent on original sanitary works under the supervision of the Sanitary Engineer, and Rs. 8,96,823 on the maintenance and repairs of open water-works, the total expenditure exclusive of the cost of preparation of schemes under the supervision of the Sanitary Engineer was Rs. 15,67,570 as shown in appendix VI of this report.

Projects to the value of Rs. 39,81,077 were finally sanctioned during the year, and schemes to the value of Rs. 53,44,853 were completed and submitted for sanction. In addition preliminary estimates to the value of Rs. 44,59,393 were submitted and work was in hand on projects to the approximate amount of Rs. 1,40,00,000.

Open water-works.—From the weekly analysis of the water supplied at the various open water-works it appears that the supply was of uniformly good quality except at Allahabad and Lucknow where the percentage of bacteriological counts over 100 per C. C. is too high and should receive the careful attention of the Superintendents concerned.

Agra.—Both the Beam engines and the High Duty Worthington engine worked efficiently throughout the year, and the usual overhauling to the latter engine was carried out during the cold weather. No spare parts were received from England, and certain necessary fittings had therefore to be made in the local water-works workshop. The Diesel engines have given entire satisfaction and have run steadily. The two mechanical filters worked efficiently throughout the year and an extension of this plant is under contemplation for the near future as it is anticipated that some additional filters will shortly be required.

Allahabad.—The overhaul of the Triple expansion engine at the unfiltered station was completed in June, and the engine has since worked well. The suction gallery of this engine cracked rather badly near the suction well and the cracked portion was dismantled and rebuilt with hoop iron binding. It is feared that this tunnel may give some trouble during the rains and require further reinforcement later. The new reinforced concrete suction tunnel for the Beam engines at Karelabagh was completed in July before the river rose, although the necessity of maintaining the water-supply by means of the Beam engines during the construction led to delays which caused considerable anxiety. Further cracks developed in the Beam engine and boiler houses, and as the whole building appeared to be in danger of collapse the necessary repairs were put in hand, after consulting the Chairman of the Municipal Board. These have now been completed and, as far as can be foreseen, all cause for further anxiety is at an end.

The much-needed overhaul of the Beam engines at Karelabagh was started by Messrs. Worthington Simpson in November, 1918, but the progress made has been rather slow owing to the necessity of re-levelling the engines and partially rebuilding and reinforcing their foundations in a rather constricted and limited space. This portion of the work is being carried out by the Municipal Engineer. It is hoped to complete the first engine "B" early in June and "A" some three or four months later.

"B" engine at the filtered station was thoroughly overhauled during the cold weather and "A" engine was partially overhauled.

It is obvious that great efforts are being made by the Chairman of the Municipal Board, Lala Sheo Charan Lal, to prevent a failure of the water-supply this year, and the thanks of the Sanitary Engineer and the residents at large are due to him for his personal interest and supervision which are now having real effect.

The filters are in fair order though the sand used is rather too fine.

The provision of new pumping plant at both stations and the adequacy of the filtration plant is under consideration as the present plant which is more or less out of date is now quite incapable of maintaining the required supply.

Benares.—As at nearly all the water-works stations in these provinces, the pumping plant at Benares and particularly that at the Bhadaini riverside station is now quite unable to cope with the increasing demand. During the past year or so the state of the plant there has steadily deteriorated. The Sanitary Engineer inspected Benares in November last and the state of affairs was so bad that entire breakdown in the water-supply seemed inevitable unless drastic steps were taken to do the necessary overhauls. On his advice the plant at the riverside station was handed over to Messrs. Worthington Simpson in March, to run and maintain for a period of six months and to generally overhaul as far as was possible during that period. The plant at the filtered station and the filters are in very fair order but both are inadequate to the present needs of the city. The question of the necessary extra plant is now under consideration.

Cawnpore.—The engines and pumps at the unfiltered station have been constantly at work throughout the year, and the river has again kept well to the water-works side, but the new canal-supply scheme is urgently needed. The scheme, in the rough, is now under the consideration of the Board. There have been no serious engine troubles this year, but it is necessary that the plant at both the stations should be increased, as the present pumps are not able to meet the demands of the town in the hot weather. The banks of the settling tanks have been raised so as to give longer settlement as well as extra storage.

The Puech Chabal installation and the final filters were well looked after and have worked well.

Lucknow.—The machinery at both the stations worked fairly well. All the engines and pumps were overhauled during the year. Owing to the demand being far in excess of the capacity of the plant the engines at the *filtered* water station are quite unable to maintain the designed head and the general efficiency of the plant has been low. This is a serious matter and a scheme for improving the supply of water to Lucknow is under consideration.

Meerut.—The machinery at Bhola has been well maintained and the filters and settling tanks have worked satisfactorily throughout the year. The flooring at the end of the tail race running into the main canal, sunk and was repaired. The consumption of water in the city and cantonments increased considerably during the year. This was largely due to the absence of rain and to the unusually large number of troops in Cantonments.

The Hydro-Electric scheme for Meerut has been completed and is now under the consideration of the municipality.

Naini Tal.—The supply from the springs was continuous during the year and there has been no need to use the lake engines and the chlorine plant: both have been well maintained and are ready for use if required. One of the new pump chambers fitted for pumping to the low level area, was apparently over-taxed and cracked. It has been replaced and a relief valve fitted so that this pump cannot now be used for pumping to either the intermediate or high-level reservoirs. The boilers have all been fitted with new headers and tubes; the economisers need a complete overhaul.

As regards the other open water-works at Mussoorie, Dehra Dun, Jhansi, Mirzapur, and Muttra there is nothing particular to record. At Mussoorie the question of additional storage is being considered, and also the increase in the water-supply by the inclusion of the Brewery springs. A request has also been made to the Board of Public Health for the preparation of a detailed scheme for the inclusion of certain springs in order to increase the present supply of Dehra Dun. The plant at the Muttra pumping station has continued to work excellently and the supply from the tube wells has been quite satisfactory. Small cracks have developed in three of the suction tunnels; tell tales have been fixed but no further movement has occurred.

ORIGINAL WORKS.—WATER-WORKS.

Agra.—The re-organisation of the distribution has been successfully completed, but the service reservoirs and the new pumps still remain. Much distressing delay has taken place in this work owing firstly to scarcity of materials and transport and secondly to the unprecedented succession of epidemics at Agra, which has rendered labour expensive and difficult to obtain. The reservoirs are nearly complete, but serious delay has taken place in the provision of the new pumping sets.

Allahabad.—In addition to the two tube wells which were put down last year, two more wells have been sunk: one at the Polo ground and the other at Mayo Hall, and they are nearing completion. Necessary pipe lines have been laid to connect up these wells with the existing water-supply mains. During the Magh Mela the temporary pumping plant in the Daraganj well pumped water satisfactorily for the pilgrims and the permanent population of the place for about a month.

Work on the improvement of the Haldwani and Ramnagar water-supplies is in hand but owing to the difficulty in obtaining materials and the rise in prices the work has been delayed. It is feared that both estimates will be exceeded.

Tube Wells.—The tube well sunk for the Military Works department at Benares was tested in July last for seven days and yielded a discharge of 13,500 gallons per hour under a depression of 13½ feet. Work on tube wells at Gulabbari (Fyzabad), for the East Indian Railway at Tundla, for the Forest department at Maheshpur Utaria, and for the Ferozabad municipality is in hand. The tube wells at Etawah, Bareilly, Shahjahanpur, and Cawnpore have been completed. This boring work has been carried out in spite of difficulty in obtaining material and tools, etc. More research work on the behaviour of tube wells should be undertaken and for this an Assistant Engineer and some surveyors are required. Experiments on the Unao Bank of the Ganges are shortly to be made and may prove of interest.

ORIGINAL WORKS.—DRAINAGE AND DRAINAGE SCHEMES.

Allahabad Drainage Works.—The work on Kydganj drainage was put in hand against a Government grant of two lakhs. The work is in progress. A scheme for the extension of the Naini Sullage farm is being prepared and is all but ready. The machinery at the Jumna Bridge sullage pumping station was inspected by a representative of Messrs. Worthington Simpson, Limited. The plant has been well maintained and is working satisfactorily. The provision of a workshop is under consideration.

Agra.—The drainage scheme for Agra city has been revised on the lines indicated by the Board of Public Health and is ready for submission, and that of Agra Cantonments is also nearly ready and will be submitted shortly.

A scheme for draining Shahgunj mohalla, and filling borrow pits in Agra municipality, at an estimated cost of Rs. 54,035 has been prepared and sanctioned. The existing sullage farm, although objectionable in many respects, has continued to work satisfactorily, and an income of Rs. 8,000 has been realized against Rs. 6,000 realised last year. A scheme for a new sullage farm is under consideration and complete surveys for it are ready.

Moradabad.—Tenders for the Moradabad drainage improvements have been called for and work will be started shortly. Owing to the high price of material the work on the flushing scheme has been postponed for the present.

Benares.—The construction work on the Beni Madho Branch sewers was carried out in the Benares municipality at a cost of Rs. 19,478.

Cawnpore.—The first two parts of the Cawnpore drainage scheme amounting to Rs. 20,67,942 have been finally sanctioned; part III amounting to Rs. 2,29,523 has been administratively sanctioned, parts IV and V amounting to Rs. 8,75,965 have been completed and submitted to the municipal board, and the remaining part VI is also ready to be forwarded to them. The construction of the Permit Bazaar engine-house has been commenced by the Executive Engineer, Third Sanitary division, and as no tender was received for the work it is being carried out departmentally. The new pumps ordered for the above station have not been received yet. A temporary pump has, however, been ordered to meet the immediate requirements.

Lucknow.—The project for the improvement of Ghazi Uddin Hyder Canal is in hand and will amount to Rs. 18,00,000.

The detailed surveys of the Trans-Gumti area are in hand and when completed the drainage scheme for this area will be undertaken.

Drainage schemes of the following parts of the municipality are being prepared by Messrs. Lane Brown and Hewlett, Engineers, Lucknow:—

(*a*) Sarkata Nala.
(*b*) Moulviganj.
(*c*) Hussainganj.
(*d*) Pata Nala.
(*e*) Ghasiari Mundi.

The project for the sullage pumping station at Lucknow is being prepared and an order to supply necessary pumps has been placed with Messrs. Mather and Platt, Limited. A sum of Rs. 22,021 was spent on the construction of the Jugali sullage farm and Rs. 11,172 on the drainage of Balrampur Hospital.

Saharanpur.—A scheme amounting to Rs. 7,000 has been prepared for extending the lining for Pandhoi Nala in connection with the anti-malarial scheme.

Dehra Dun.—The drainage work in Dehra Dun is in progress. The underground storage reservoir for canal water has been completed, and the pipe line pail depôts, latrines are well on the way to completion. This work has been delayed owing to the want of fittings both for the pipe line and latrines. The outfall extension and sewage farm are almost complete. A sum of Rs. 26,189 was spent on these works during the year under report.

Mussoorie.—The Landour Bazaar drainage work has been completed except the North Road extension which will be ready shortly. Owing to Miller's syphons not being procurable in the markets, locally-made substitutes were used but they are, it is feared, a failure.

Muttra.—Muttra sewerage scheme is under preparation. The scheme amounting to Rs. 22,144 for Holi Darwaza sewer connecting standposts has been prepared and the work will be shortly started.

Almora.—A sum of Rs. 9,542 was spent on the Almora sewerage work. The work is in progress.

Bareilly.—The Bareilly sewerage and flushing scheme amounting to Rs. 33,09,800 has been prepared and forwarded to the municipal board, and it is now under their consideration.

The question of increase in the staff of the department is now under the consideration of Government. At present the staff is inadequate to cope with the work thrown upon it, and the demands on the Sanitary Engineer both for general supervision of open water-works, municipal works, preparation of projects, and construction of sanitary works are steadily increasing.

During the war the department has struggled to cope with its work with a depleted staff, but this state of affairs cannot continue indefinitely.

The Sanitary Engineer's special thanks are due to Messrs. Hoey, Platt, and Knox for the help and advice they have at all times, cheerfully and willingly, given him, and for the way they have kept work going under very difficult and trying circumstances.

The following staff has been especially mentioned by the Executive Engineers in their reports :—

I Sanitary division.—Mr. Ishaq Khan, Assistant Engineer, Babu Puran Mal, Temporary Upper Subordinate, Babu Lajpat Rai, Overseer, Babu Jagan Prasad, Clerk, M. Ataul Haq, Draftsman.

II Sanitary division.—Mr. T. D. Kochhar, Assistant Engineer, Babu Khan Chand, Sub-Overseer.

III Sanitary division.—Mr. K. Chattopadhya, Assistant Engineer.

Boring division.—Mr. J. N. Mittra, Assistant Engineer.

The Sanitary Engineer wishes to add the following to the list :—

Babu Balram Das, Mechanical Upper Subordinate.
Babu Hardeo Behari Lal, } Clerks.
Babu Budh Prakash Chand, }

A. C. VERRIERES, C.I.E.,
Sanitary Engineer to Government,
United Provinces.

Dated NAINI TAL :
The 31st May, 1919.

APPENDIX

Statement of opera

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
Population.				
1. By Census of 1911, in Municipality	163,935	159,701	199,868	173,981
2. " " cantonments	21,514	11,996	3,936	21,517
3. Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868	173,981
Consumption of water.				
4. During the year including cantonments in gallons.	1,313,843,600	1,407,486,403	1,742,365,267	2,113,290,155
5. Daily average, including cantonments in gallons.	3,599,572	3,856,127	4,773,606	5,789,836
6. Maximum daily average in any one month in gallons.	3,959,655	4,712,400	6,519,469	6,866,594
7. Water used for irrigation and manufacturing purposes in gallons.	169,524,498	423,158,464	22,960,000	545,625,115
8. Water used for domestic purposes in gallons.	1,144,319,102	984,327,939	1,719,405,267	1,567,665,000
9. Consumption per head for domestic purposes in gallons.	16·90	15·70	23·56	24·68
10. Consumption per head for trade in gallons.	2·51	6·70	·31	8·59
Total ...	19·41	22·40	23·87	33·27
11. Daily average for cantonments alone	290,911	214,020	2,338	...
12. Number of house connections during 1918-19.	41	51	151	201
13. Number of metered connections ...	121	358	6 house meters 35 district meters.	53
Annual Receipts and Charges.				
14. Maintenance charges ... Rs.	100,647	140,900	137,586	172,476
15. Cost per 1,000 gallons consumed ...	1·23 annas	1·60 annas	1·26 annas	1·30
16. " " per 100 feet lift	·64 "	·94 "	·77 "	·75
17. Cost of water per 1,000 gallons, including interest and sinking fund charges.	2·85 "	3·1 "	·99 " 2·8	2·05
Lift of Pump.				
18. From river to settling tanks ...	45 feet	94 feet	90·78 feet	100·8 feet
19. From filtered water pumps to town distribution.	147 "	76 "	72·56 "	71·8 "
Total lift ...	192 "	170 "	163·34 "	172·6 "
Income from water-works.				
20. Water rate recovered during the year Rs.	97,240	1,39,353	1,42,436	1,56,610
21. Sale of water and other receipts Rs.	77,785	40,519	5,740	1,15,266
Total Income Rs.	1,75,025	1,79,872	1,48,176	2,71,876

No. I.

tions during the year 1918-19.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
240,016	76,755	11,985	16,788	30,301	58,236	55,304	54,332
19,782	39,876	2,511	1,239	Nil	11,970	Nil	3,581
177,935	116,631	11,000	18,027	30,301	25,000	38,400	54,332
1,511,512,000	546,099,135	57,555,577	32,628,102	65,910,240	47,102,416	217,586,250	139,385,840
4,141,129	1,496,162	157,686	89,392	180,576*	1,29,048	596,126	381,877
4,500,000	1,857,987	206,095	203,308	180,576	143,736	1,429,770	675,000
68,431,000	9,935,836	Nil	374,209	Nil	4,396,000	18,000,000	Nil
1,443,081,000	536,163,299	57,555,577	32,253,893	65,910,240	38,392,416	199,586,250	139,385,840
22·06	12·60	14·33	4·90	5·95	4·20	14·24	7·02
1·05	·23	Nil	0·06	Nil	·48	1·28	Nil
23·11	12·83	14·33	4·96	5·95	4·68	15·52	7·02
302,816	702,730	873	3,702	Nil	11,819	Nil	Nil
172	17	344	250	Nil	14	16	125
291	36	345	225	Nil	4	293	Nil
176,390	34,024	29,216	52,548	4,459	12,916	11,747	28,914
1·86 annas	1·00 annas	8·12 annas	Rs. 1·61	1·08 ans.	4·39 ans.	·86 annas	2·74 ans.
1·18 ,,	·78 ,,	·57 ,,	Rs. 0·04	Nil	...	Nil	2·00 annas.
3·01 ,,	2·32 ,,	Rs. 1·08	Rs. 2·31	Rs. 3·36	5·41 ans.	2·12 ans.	4·3 ans.
112 ft.	15·16 ft.	Main pump 1,700′	Tonnochy 1,160′ Ayarpatta 1,093′	...	...	Gravitation scheme.	15·17
45·5′	126·41′	Auxiliary 600′	Inter Cheena 450′ Inter Ayarpatta. 400′	...	170·13	...	121·83
157·5 feet	141·57 feet	...	Pilgrim 240′	...	170·13	...	137 feet
94,464 1,26,584	... 72,222	35,029 12,258	32,470 15,047	... 2,583	6,937 2,248	... 8,192	24,448 Nil
2,21,048	72,222	47,287	47,517	2,583	9,185	8,192	24,448

* Excluding cantonment.

APPENDIX No. II.

Annual maintenance accounts of water-works in the United Provinces during the year 1918-19.

Name of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
1. *Establishment.*	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(a) Permanent establishment.	34,722	25,080	32,859	35,548	32,528	13,401	16,557	10,994	2,501	1,595	2,722	8,904
(b) Office contingencies.	1,523	342	1,593	140	901	4,360	1,110	297	250	115	203	255
(c) Rent ...	334	1,520	270	816	430	60	...	...	...	...	...	3
2. *Pumping.*—												
(a) Coal ...	34,171	57,071	65,146	59,176	87,650	2,655	...	29,808	...	5,081	...	2,734
(b) Oil and waste	5,926	11,816	7,230	10,072	6,233	1,075	3,102	1,104	...	637	...	3,239
(c) Other stores	7,961	5,172	7,208	5,880	8,979	4,603	3,799	1,183	...	1,517	...	438
3. *Intake.*—												
(a) Training river.	...	...	...	513	...	...	...	...	...	1,059	...	...
(b) Cleaning channels and wells.	4,689	1,042	4	...	47	950	...	...	...	...	...	311
4. *Settling tanks and filters.*—												
(a) Cleaning settling tanks.	712	5	1,416	5,845	14,037	50	...	...	...	...	...	...
(b) Clearing and renewing filter beds.	3,720	3,000	1,154	6,491	592	1,064	...	...	...	...	...	...
(c) Purchase of sand.	10,115	3,160	3,060	5,694	9,522	656	...	...	...	...	...	...
(d) Purchase of alluminoferric.	...	...	6,782	10,494	...	2,428	...	...	...	...	...	...
5. *Distribution.*—												
(a) Pipes and fittings.	2,516	3,042	2,150	5,776	1,997	1,600	364	2,420	1,628	2,204	1,406	2,649
(b) Meters ...	571	201	...	7,492	438	...	536	324	...	274	5,943	63
6. *Repairs.*—												
(a) To tanks ...	288	2	...	...	17	...	293	99	...	146	...	2,710
(b) To buildings and grounds.	2,115	1,606	1,649	2,383	752	423	987	149	...	285	1,164	1,064
(c) To machinery.	1,094	27,898	5,523	15,951	12,035	...	2,413	5,223	...	...	...	926
(d) To rising main.	...	...	643	...	...	...	...	...	...	...	...	...
7. *Water analysis.*—	140	943	...	205	232	199	55	947	80	3	309	566
Total ...	100,647	140,900	137,586	172,476	176,390	34,024	29,216	52,548	4,459	12,916	11,747	23,914

* Fuel oil.

APPENDIX No. III.

Statement showing initial capital cost of subsequent extensions and improvements incurred on water-works in the United Provinces to the end of 31st March, 1919.

Water works stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extensions during 1918-19.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	15,33,853	1,95,383	28,99,997
Allahabad	16,24,061	7,68,041	60,109	24,52,211
Benares	25,61,881	7,55,011	13,641	33,30,533
Cawnpore	14,44,570	10,21,445	7,029	24,73,044
Lucknow	15,15,736	8,19,585	2,120	23,37,441
Meerut	7,51,710	50,159	1,999	8,03,868
Mussoorie	4,79,754	1,63,617	25,229	6,68,600
Naini Tal	2,47,000	4,11,960	8,617	6,67,577
Dehra Dun	97,241	80,853	421	1,78,515
Mirzapur	6,29,508	42,155	Nil.	6,71,663
Jhansi	96,556	57,055	4,466	1,58,077
Muttra	4,95,924	Nil.	6,703	5,02,627

APPENDIX No. IV.

Statement showing rate of filtration and results of water-works of the United Provinces during the year 1918-19.

Municipalities.	Rate of filtration in gallons per square foot in 24 hours.			Chemical Analysis.			Bacteriological analysis.		Mechanical filter samples.
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.	
Agra ...	34·30	32·00	33·32	2	...	2	79	1 Nil.	15
Allahabad ...	49·60	12·40	37·71	1	...	1	471	16	
Benares ...	50·80	18·75	35·18	2	...	2	363	5	
Cawnpore ...	52·00	5·00	38·60	2	...	2	231	2	
Lucknow ...	59·30	1·50	28·10	2	...	2	328	17	
Meerut ...	37·50	18·00	31·70	2	...	2	188	5	
Mussoorie ...	...	...	...	...	...	...	...	...	
Naini Tal ...	...	...	...	2	...	2	...	...	
Muttra ...	...	...	...	...	...	...	51	5	

APPENDIX No. IVA.

Statement showing the use of filters at various water-works during the year 1918-19.

Municipalities.	Rate of filtration in gallons per square foot per day		Rate of filter not always out of operation during the year.
	Average rate on total filtering area.	Average rate on area in operation (vide Appendix IV)	
Agra	25·71	33·32	22·84 per cent.
Allahabad	32.13	37·71	14·80 „
Benares	29·83	35·18	15·21 „
~~Cawnpore~~	~~41·55~~	38·57	...
~~Lucknow~~	~~29·57~~	28·10	...
Meerut	24·93	31·70	21·86 per cent.

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising mains, etc.,

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
1. Consumption of water per capita in gallons per diem.	19·41	22·40	23·87	33·27
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868	173,981
3. Water used for irrigation and manufacturing purposes.	169,524,498	423,158,464	22,960,000	545,625,115
4. Power of pumps per hour in gallons at river.	2. Horizontal pumps each 28 H. P. Designed for 84,000 Maximum 96,000 Average 78,000 1. Worthington low duty pump. Designed for 120,000 Maximum 132,000 Average 102,000 2. Diesel Engines 55 H. P. Designed for 180,000 Maximum 228,000 Average 192,000	2 Beam Engines 102 H. P. Designed for 126,000 Maximum 154,961 Average 114,862 1. Triple Expansion Engine 120 H. P. Designed for 192,000 Maximum 192,000 Average 156,250	2. Horizontal Engines each 120 H. P. Designed for 252,000 Maximum 234,388 Average 176,423 1. Worthington high duty pumping engine 235 H. P. Designed for 500,000 Average 382,710	2. Engines each 86 H. P. Designed for 187,500 gallons. Maximum 187,500 Average 154,467 1. Engine 100,H.P. Designed for 217,500 Maximum 235,000 Average 208,580
5. Power of pumps per hour in gallons at filter.	2. Beam Engines each 100 H. P. Designed for 192,000 Maximum 200,000 Average 180,000 1. High duty Worthington 130 H. P. Designed for 150,000 Maximum 156,000 Average 144,000	2. Beam engines each 135 H. P. Designed for 223,300 Maximum 265,000 Average 188,453	4. Beam engines each of 820 H. P. Designed for 450,000 each set (2 engines) Maximum 357,458 Average 336,562	Two engines each 80 H. P. Designed for 187,500 Maximum 187,500 Average 171,180 One engine. Designed for 283,140 Maximum 338,238 Average 288,470
6. Number of rising mains...	2	2	2	2
7. Length of rising mains ...	2·5 and 1·75 miles respectively.	3·8 miles	Old rising main 4,727′ New „ „ 4,100′	1·32 miles ...
8. Size of rising mains ...	28″ and 18″	20″	Both 24″	Each 20″ dia.
9. Number of settling tanks.	5	3	3	3
10. Size of settling tanks ...	Each 266′ × 151′	Each 280′ × 180′	403·5′ × 252·5′ × 15′	Each 355′ × 255′ ...
11. Capacity of settling tanks in gallons.	2,200,000	1 and 3=4,400,620 2=4,455,626	1 and 3=6,436,120 2=6,508,927	Each 3,000,000 ...

No. V.

in the water works of the United Provinces for 1918-19.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
23·11	12·83	14·33	4·96	5·95	4·68	15·52	7·02
177,935	116,631	11,000	18,027	30,301	25,000	38,400	54,332
68,431,000	9,935,836	Nil	3,74,209	...	4,396,000	18,000,000	Nil.
2 Engines of 130 H. P.	One engine of 26 H. P.	*(a)* Main pump designed for 10,800.	Engine ...	...	2 Compound piston pumps each capable of discharging 13,200 gallons per hour.		
Designed for 187,500 Maximum 188,237. Average 178,517.	Two turbines 90 H. P. Designed for 72,000. Maximum 61,985. Average 37,037.	Average 10,900. Maximum not known. *(b)* Auxiliary pumps. Designed for 4,800. Average 5,000. Maximum not known.	Lake station Designed for 14,355. Three engines each 31 H. P. No. 1 Engine, plunger 5′ 13,104 gallons. No. 2, Engine 3¼″ 5,160 gallons. No. 3 Engine 3¼″ 5,160.	... ...			2 Diesel of 100 H. P. crude oil engines and dynamos. 2 Motor-driven centrifugal pumps to deliver 60,000 gallons per hour. Actual discharge 81,000 gallons per hour.
3 Engines of 110 H. P.	Second lift pump driven by same power.	*(a)* Main pump (motor driven two designed for 150 H. P.)	...	...		...	
Designed for 187,500. Maximum not known Average 178,000.	Designed for 66,000. Maximum 50,611. Average 30,327.	*(b)* Auxiliary pump (motor driven) two designed for 23 H. P.	...				
1	1	2	5	...	5	1 Gravitation main.	1
3·5 miles...	15″ main = 38,292′. 13″ main = 8,550′.	Murray springs 6,000 feet. John Mackinnon springs 1,400′.	Ayarpatta ·93 miles. Tonnochy ·66 miles. Pilgrim ·34 miles. Inter Cheena ·49 miles. Inter Ayarpatta ·25 miles.		... 1=3·65 miles 2=0·70 miles. 3=1·6 miles 4=30·40 ft. 5=50·40 ft.	5·73 miles	4,817 feet.
20″	13″ and 15″	Murray springs 5″. John Mackinnon springs 3½″.	4″, 3½″, 3,″ 4″, 5″.	2½″ and 3″ main pipe-line.	9″,6″,6″,4″,3″.	12″ diameter	12″
3 250′×200′×13′6′ each 4,000,000	3 100′×60′×11′ 5,28,000 each.	... ...	... ...				

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising mains, etc.,

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
12. Number of filters ...	7+1 mechanical filter.	6	8	7
13. Size of filters ...	200′×100′	200′×100′	200′×100′×6′—4½″	200′×100′
14. Number of C. W. reservoirs	3	2	2	2
15. Size of C. W. reservoirs	103′× 105′ × 10′	Each 160′×103·3 × 12′	178⅓′×148⅓′ ×12′	Each 135′ ×106⅔′ ×12′ deep.
16. Capacity of C. W. reservoirs in gallons.	676,000 each	1,240,000 gallons each.	1,854,068	Each 9,53,300 gallons.
17. Number of service reservoirs or stand pipes.	3	1	1	2
18. Size of service reservoirs	1 66′ dia. × 11½′ deep. 2 20′ dia. × 50′ deep.	60′ dia.×11′ deep	60′ dia. ×15′ deep	Balancing tanks 50′—6″ high×36′ dia. 50′—6″ high× 40′ dia.
19. Capacity of service reservoirs.	1 438,000 2 200,000 each	194,000 gallons	265,000	Holds 318,087 and 392,700 gallons respectively.
20. Number of public stand-posts.	Four-tap stand-posts each ¾″ size ... 42 Two-tap stand-posts of ¾″ size ... 78 One-tap stand-posts ... 173	One-tap stand-posts ... 144 Two-tap stand-posts ... 59 Four-tap stand-posts ... 80 Waste-not cocks 13 Push cocks ... 13 Wall boxes ... 7 Bib cocks of ¾″ 6	One-tap stand-posts ... 245 Two-tap stand-posts ... 108 Four-tap stand-posts ... 80	Four-tap stand-posts ... 60 Two-tap stand-posts ... 61 One-tap stand-posts ... 63 Tap stand-posts 48 Bathing platforms 5

No. V.

in the water works of the United Provinces for 1918-19—(concluded).

[illegible]cknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
7	4	...	1 chlorine plant.	...	...	...	
200′×100′	150′×100′	...	...	...	...	...	
2	1	4	7	...	...	...	
Each 105′×107′×12′ deep.	48′×52½×7′ deep.	2×(40′×25′×8′). 1×(30′×20′×8′). 1×(80′×24′×6′).	45′×40′×6′ at W. W. station.	...	...	...	
798,500 gallons each.	110,600	2 of 50,000 gallons each 1 of 30,000 gallons. 1 of 72,000 gallons.	67,500	...	...	...	
1	2	18 Iron Service Tanks.	82 Small service reservoirs and 6 large service tanks.	25	1	1	2
66′×12′	each 25′×34′.	1. 10′×10′×4′. 4. 8′×8′×4′. 10. 8′×4′×4′. 5. 4′×4′×4′.	Small service tanks: 32 of 3′×3′ 29 of 2′—8″×3′, 1 of 4′×3′ 3 of 4′×5′ and 17 square tanks 6′×8′×4′ Large Service tanks:— 1 of 36′×15′×9·5′. 2 of 22·5′×13·33′. 1 of 29·5′×15′×9·5′. 1 of 20′×10′, 1 of 18′×10′.	Service reservoirs holding 192,225 gallons.	40′×15′×8′.	200′×75′	32′ dia. and 20′ high each.
250,000	100,000 gallons.	1 of 2,500 gallons. 4 of 1,600 gallons. 10 of 800 gallons. 5 of 400 gallons.	Total capacity of small reservoirs 32,200 gallons. Total capacity of large service reservoirs 185,874 gallons.	...	30,000 gallons.	208,446 ...	100,000 gallons each.
One-tap 102 standposts *Two-tap* standposts 228	One-tap standposts of ¾″ 40 Two-tap standposts of ⅞″ 30 Wall fountains 3 Taps of ½″ 4	Two-tap standposts 32.	stand-post 27.	15 tanks of G. I. sheets, different sizes holding 2,290 gallons; 13 standposts with 2 brass cocks and 4 standposts with one brass cock.	Service tank with 50 taps 1. Iron tanks with 6 taps each 7. Standposts with two taps each 10.	One-tap standposts ... 34 Two-tap standposts ... 27 Four-tap standposts 9 Hydrants 11 Wash out, 7	Two-tap standposts 57. One-tap standposts 37. Standpipes 11.

APPENDIX No. VI.

Detailed statement of the expenditure incurred on works of sanitary nature executed under supervision of the Sanitary Engineer during the year 1918-19.

No.	Names of places.	Water works (original and special repairs).	Water works Maintenance.	Drainage works.	Other works.	Total.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	Agra	1,95,383	1,00,647	55,673	2,692	3,54,395
2	Allahabad ...	74,180	1,40,900	9,191	...	2,24,271
3	Benares ...	21,038	1,37,586	19,478	...	1,78,102
4	Cawnpore ...	29,782	1,72,476	...	...	2,02,258
5	Lucknow ...	16,193	1,76,390	33,193	743	2,26,519
6	Meerut... ...	1,999	34,024	...	2,633	38,656
7	Mussoorie ...	25,229	29,216	32,155	...	86,600
8	Naini Tal ...	8,617	52,548	...	...	61,165
9	Dehra Dun ...	421	4,459	26,188	...	31,068
10	Jhansi	4,466	12,916	...	...	17,382
11	Mirzapur ...	...	11,747	...	...	11,747
12	Muttra ...	6,703	23,914	...	...	30,617
13	Fyzabad ...	12,603	...	...	...	12,603
14	Almora ...	2,177	...	9,543	...	11,720
15	Bahraich ...	152	...	...	...	152
16	Fatehgarh ...	589	...	...	...	589
17	Maheshpur Uttaria...	567	...	...	...	567
18	Ghazipur ...	...	...	2,671	2,531	5,202
19	Etawah ...	5,691	...	...	...	5,691
20	Aligarh ...	868	...	...	...	868
21	Khurja ...	...	...	1,556	...	1,556
22	Ramnagar ...	524	...	...	...	524
23	Haldwani ...	40,608	...	...	...	40,608
24	Hardwar ...	974	...	...	...	974
25	Tundla ...	4,152	...	...	...	4,152
26	Ferozabad ...	3,154	...	...	...	3,154
27	Bareilly ...	6,554	...	...	...	6,554
28	Shahjahanpur ...	9,876	...	...	...	9,876
	Total ...	472,500	896,823	189,648	8,599	15,67,570

APPENDIX No. VII.

Comparative statement of working expenses of water works schemes in the United Provinces for the year 1918-19.

Number.	Name of water works.	Class of work gravitation or pumping.	Coal consumption per 1,000 feet gallons.	Price of coal per ton.	Total lift including friction.	Percentage of charges for--			Average consumption in gallons per head per day.	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet gallons for pumping schemes.	Cost of maintenance per head of population.	Cost of coal per 1,000 feet gallons.	Income per head of population.	Remarks.
						Establishment.	Coal.	Other charges.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			lbs.	Rs. a. p.						As.	As.	As.	As.	As.	
1	Agra ...	Pumping	·0213	14 3 3	192·0 feet.	24·56	33·95	41·49	19·41	1·23	·0064	8·68	·00216	15·10	
2	Allahabad ...	,,	·0413	12 15 0	170·0 ,,	17·79	40·50	41·71	22·40	1·60	·0094	13·13	·00380	16·76	
3	Benares ...	,,	·0394	13 0 0	163·34 ,,	23·88	47·34	28·78	23·87	1·26	·0077	10·80	·00365	11·69	
4	Cawnpore ...	,,	·0347	10 7 6	172·6 ,,	20·61	34·30	45·09	33·27	1·30	·0075	14·11	·00259	22·25	
5	Lucknow ...	,,	·0783	10 8 4	157·5 ,,	18·44	49·69	31·87	23·11	1·86	·0118	10·86	·00588	13·61	
6	Meerut ...	Turbines worked by water power	...	...	141·57 ,,	39·38	7·80	52·82	12·83	1·00	·0070	4·67	...	9·90	
7	Mussoorie ...	Pumping ...	...	...	Main Pumps—1,700′ Auxiliary 600′	56·67	...	43·33	14·33	8·12	·0076	32·25	...	52·19	
8	Naini Tal ...	Pumping and gravitation.	·0838	36 8 0 Wood at Rs. 10 per 100 maunds	Tonnochy 1,160′ Ayarpatta 1,093′ Inter Cheena 450′ Inter Ayarpatta 400′ Pilgrim 240′	20·92	56·72	22·36	4·96	25·76	·0385	46·63	·02184	42·17	
9	Dehra Dun ...	Gravitation	...	...	...	56·08	...	43·92	5·95	1·08	...	2·35	...	1·33	
10	Jhansi ...	Pumping ...	·1177	12 1 3	170·13 feet.	12·34	39·33	48·33	4·68	4·39	·0258	2·94	·01015	2·09	
11	Mirzapur ...	Gravitation	...	...	...	23·17	...	76·83	15·52	·86	...	3·39	...	2·37	
12	Muttra ...	Pumping	*·0037	Fuel oil 85 0 0	137·80 ,, *	37·23	11·43	51·34	7·02	2·74	·0198	6·60	·00224	6·75	*Fuel oil.

APPENDIX No. VIII.

List of projects finally sanctioned during the year 1918-19.

	Rs.
Agra Emergency Canal Water Supply	6,497
Do. Settling Tank no. 1 providing baffle wall	994
Do. Tajganj service reservoir (supplementary)	2,658
Do. Thomason and Lady Lyall Hospital drainage	28,116
Do. Shahganj drainage and borrow pits filling	54,035
Allahabad Karelabagh reinforced concrete suction tunnel	21,425
Ditto ditto Suction tunnel (supplementary estimate)	7,841
Ditto ditto C engine house repair and overhaul of C engine (revised estimate)	21,537
Allahabad Karelabagh pumping station drainage	3,249
Ditto ditto repairs to boiler and Beam Engine houses	17,746
Ditto ditto repair to chimney	1,172
Ditto Magh Mela water supply	5,493
Ditto Mahabaruni water supply	1,123
Ditto Kydganj drainage work	3,19,075
Bahraich Flushing Scheme	51,870
Do. Water supply	1,11,277
Ballia Rat Proof Grain godown	69,985
Benares Water supply (Tube well)	1,14,675
Do. Water Works meter house	21,425
Do. tube well test pumping	2,704
Benares tube well (Military Department)	7,165
Bareilly tube well (Military Department)	6,658
Cawnpore additional connection from low level sewer rising main to main sewer at Mall Road	14,700
Cawnpore drainage scheme, parts I and II	20,67,942
Do. East Indian Railway tube well (revised)	8,939
Dehra Dun Arhat bazar drainage	15,860
Do. sewerage extension and sullage farm	9,665
Fatehgarh Central Jail water supply	2,667
Fyzabad, Gulab Bari Tube Well	2,517
Do. Water supply (supplementary)	10,107
Do. Water supply engine and other foundation oil reservoir overhead oil tank	4,695
Ferozabad Tube Well	13,264
Gola Tube Well Engine House and driver quarters	7,701
Haldwani water supply (revised)	80,091
Khurja drainage scheme	18,212
Do. tube well preliminary works at—	525
Lucknow tube wells	1,27,503
Do. Eastern intercepting sewer and sullage farm	2,75,512
Latrines for schools, type design for—	1,086
Do. for subordinates, type design for—	447
Mahespur Uttaria (Bareilly) tube well	8,193
Meat Markets 48 stalls, type design for	10,313
Ditto 24 ditto	7,669
Ditto 12 ditto	2,859
Mussoorie Landour bazar drainage scheme	2,94,464
Do. Outfall sewer extension and sullage farm	10,179
Muttra water supply (supplementary)	16,476
Do. water supply watertight door for well tunnel	702
Do. balancing tank	7,907
Nagina drainage improvements	6,763

	Rs.
Ramnagar water supply	19,762
Sardhana drainage scheme	25,634
Shahjahanpur Cantonment tube well	5,894
Ditto Military department tube well	8,217
Tundla tube well, East Indian Railway	8,777
Total ...	39,81,077

List of projects submitted but not sanctioned during the year 1918-19.

Aligarh district Jail 5″ tube well		8,411
Do. district Jail 9″ tube well (alternative)		5,098
Allahabad University tube well		10,474
Bareilly drainage scheme		33,09,800
Do. Cantonment tube well and engine house		4,081
Bijohi (Moradabad) Glass Works tube well		4,395
Cawnpore drainage scheme, part III		2,29,523
Ditto ditto, parts IV and V		8,75,965
Ditto ditto, part VI		1,39,259
Cawnpore Ganges Flour Mills tube well		3,435
Deoband Islamia College drain diversion		12,197
Etawah tube well (revised)		21,694
Gorakhpur district Jail tube well		4,380
Jhansi water supply— (Preliminary)		
Babina A	18,26,500	
Babina B	14,37,286	
Chamrawa	11,95,607	
	44,59,393	
Lucknow sewage pumping station (for temporary plant) ...		2,00,007
Muttra water works. Addition to water works superintendent's quarters		5,904
Muttra Grass Farm tube well		17,047
Patti drainage scheme		14,504
Unao water supply		1,07,947
Ujhani drainage scheme		3,70,732
Total ...		53,44,853

List of projects under preparation during the year 1918-19.

Agra Cantonment drainage scheme	6,40,520
Do. sewerage and flushing scheme (amended)	32,16,417
Do. Mechanical filter	1,27,082
Do. Settling tanks No. I, II, and III (remodelling) ...	22,472
Do. Subzimandi storm water drain	5,090
Allahabad (Naini) sewage farm (re-arrangements for) ...	20,000
Do. Water supply (re-organisation)	5,00,000
Do. unfiltered water supply (revised)	2,70,000
Amroha slaughter house	4,000
Bareilly slaughter house	20,000
Balrampur drainage	6,00,000
Benares water supply (re-organisation)	5,00,000
Brindaban water supply	41,373
Budaun drainage	40,000
Cawnpore sullage farm	6,46,000
Do. tube well at Unao bank	20,000
Chandausi drainage	40,000

	Rs.
Dehra Dun drainage scheme (revision)	88,611
Gorakhpur drainage scheme	8,00,000
Hapur flushing scheme	90,322
Hardwar union water supply	4,94,743
Kaimganj drainage	12,000
Kosi drainage	5,099
Do. water supply	1,97,287
Lucknow water supply (re-organisation)	10,00,000
Do. sewage pumping station (permanent plant)	3,50,000
Do. Ghaziuddin Haider Canal improvements	16,50,000
Do. Trans-Gumti survey	6,00,000
Mahoba water supply	1,50,000
Meerut Hydro-Electric scheme	14,59,200
Muttra sewerage scheme	2,00,000
Do. drainage of standposts	22,144
Muzaffarnagar flushing scheme	99,687
Saharanpur Paondhoi lining	7,000
Total	1,39,49,547

TWENTY-THIRD ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31ST MARCH, 1918.

ALLAHABAD:
PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS, UNITED PROVINCES
1918.

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Twenty-third Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March, 1918.

Establishment.—The post of the Sanitary Engineer was held by Mr. C. H. West throughout the year.

The following officers were employed in the Sanitary Department under the Sanitary Engineer :—

(1) Mr. G. McC. Hoey, Executive Engineer in charge of the I Sanitary Division, Saharanpur.

(2) Mr. S. E. Platt, Assistant Sanitary Engineer in charge of the II Sanitary Circle, Allahabad. He also worked as the Personal Assistant to the Sanitary Engineer.

(3) Mr. A. S. Knox, Assistant Sanitary Engineer in charge of the III Sanitary Circle, Cawnpore.

(4) Mr. E. W. Beveridge, Temporary Executive Engineer in charge of the Well Boring Operations Division, Cawnpore.

In addition to these there were 8 Assistant Engineers, 1 Upper Subordinate, 4 Temporary Upper Subordinates, 26 Lower Subordinates, 30 Draftsmen and necessary clerical staff and work establishment.

The following stations were visited by the Sanitary Engineer and his assistants during the year :—

Agra, Allahabad, Benares, Cawnpore, Lucknow, Meerut, Mussoorie, Naini Tal, Dehra Dun, Jhansi, Muttra, Gobardhan, Brindaban, Saharanpur, Kathgodam, Bareilly, Hardwar, Fyzabad, Ramnagar, Hardoi, Nimsar, Kaimganj, Patti, Haldwani, Dhampur, Balrampur, Gola Gokarannath, Pilibhit, Shahjahanpur, Tundla, Sitla Gadhera (Haldwani), Bahraich, Deoband, Aligarh, Hapur, Khurja, Etawah, Jaunpur and Amritsar.

Expenditure.—The sum of Rs. 8,03,900 was spent on original sanitary works under the supervision of the Sanitary Engineer and Rs. 8,14,420 was spent on the maintenance and repairs of open water-works, the total expenditure exclusive of the cost of preparation of schemes under the supervision of the Sanitary Engineer was Rs. 16,18,320 as shown in Appendix VI of this report.

Project work.—The total value of projects dealt with by the Sanitary Branch amounted to Rs. 1,54,23,597. Of these projects of the value of Rs. 6,28,475 were sanctioned and to the value of Rs. 63,27,614 were completed and submitted for sanction. The remainder to the value of Rs. 84,67,508 were still under preparation.

Open water-works.—From the weekly analysis of the water supplied at the various open water-works it appears that the supply was of uniformly good quality.

Naini Tal.—At Naini Tal one engine has been fitted with larger plungers for pumping to the intermediate and low level systems. This is a great improvement and effects a considerable saving in coal.

Owing to the abnormal rainfall in 1917 there was no occasion to use the chlorine plant, but it has been maintained in good order and is ready for use if required.

Agra.—At Agra the pumping plant has been maintained in good condition, but as there is no stand-by plant there is always the possibility of an interruption of the supply in case of any trouble with the plant. The new plant ordered for Agra has not yet arrived, but a priority certificate for one set of engines and pumps to act as a stand-by has been obtained.

The mechanical filters installed at Agra have given very satisfactory results in working both as roughing filters and as final filters.

Allahabad.—At Allahabad there was a serious breakdown of the pumping plant at the riverside station in September, and although the supply never failed entirely owing to water being available from three tube wells, serious inconvenience was caused and a satisfactory supply was not restored until early in November.

A full enquiry was made into the causes leading to this breakdown, and a report was submitted to the Municipal Board. There were undoubtedly difficulties to be overcome owing to the floods in the Jumna and the unstable condition of the site of the water-works intake; but the conclusion arrived at is that with a thoroughly competent staff, a full supply of good fitting spare parts and proper attention to ordinary maintenance most of the trouble experienced at Allahabad could have been avoided. All necessary repairs and overhauls are in hand and will be completed shortly. The flywheel engine is being completely overhauled by Messrs. Worthington Simpson and Co., as the overhaul done last year by the Water Works Superintendent was not quite satisfactory. The small portion of the new gallery which was damaged last year by carelessness on the part of the water-works staff is being repaired, and a new ferro concrete tunnel is being constructed to replace the two old tunnels for "A" and "B" engines which were also damaged some years ago.

Cawnpore.—At Cawnpore there was considerable improvement in the unfiltered water-supply as the cold weather channel of the river which for some years had left the Cawnpore bank and gone to the opposite side returned to the old bed under the pumping station. So the supply of water from the canal which was taken to make good the shortage from the river was no longer required. This resulted in a large saving, as the canal charges for water are very high. The machinery at Cawnpore was maintained in good order and the roughing filters were much improved by changing and regrading the filtering media. There is little doubt that with the large demand for water in Cawnpore, three more prefilters are required, and an estimate for these should be sent in as early as possible.

Lucknow.—At Lucknow the breakdown of the pumping plant which occurred early last year continued to give trouble and the supply of water had to be considerably curtailed till the plant at Gaughat was overhauled. This has now been done, and it is hoped that no further trouble will be experienced at this station. Most of the trouble was due to neglect in doing ordinary petty repairs when needed and allowing the plant to run down. The monthly reports show a very low figure for working efficiency both at the filtered and unfiltered stations at Lucknow, and it is hoped that during the year this state of affairs will be remedied. The tube wells put down at Aishbagh are now being worked regularly with the air compressor plant purchased last year from the North-Western Railway. This forms a useful stand-by in case of any shortage in the supply.

Benares.—At Benares some difficulty has been experienced in getting spare parts for renewals, but the water-supply has on the whole been well maintained. The coal consumption at this station is higher than it should be, and there is no doubt that with greater attention to details of maintenance the working efficiency of the plant could be improved. The two tube wells put in last year have not yet been brought into use as it is impossible to get the necessary pumping plant without priority assistance.

The waste meter system has been in regular use, but full advantage is not being taken of it, and a good deal more might be done to reduce waste than is being done at present.

As regards the other open water-works at Mussoorie, Meerut, Jhansi and Dehra Dun, there is nothing very particular to record. At Dehra Dun the supply was increased by taking in a few additional springs, and at Jhansi some expenditure was incurred in improving the pumping station and intake at the Pahuj reservoir.

ORIGINAL WORKS—WATER-WORKS.

Agra.—The work on relaying the water-works mains has been practically completed, but work has been delayed on the raised reservoirs and the engine-house owing to the shortage of coal for brick-burning. The new engines required have not been secured owing to the want of a priority certificate. A priority certificate for one engine set which is practically ready has now been obtained and it is hoped that it will be received sometime this year.

Muttra.—At Muttra the water-supply from tube wells was started last July and is proving quite satisfactory.

The pumps are motor driven centrifugals worked by current generated at the water-works station by Diezel engines and dynamos.

Fyzabad and Ajudhia.—A similar installation was put up for Fyzabad and Ajudhia. The pumping station plant and wells which were financed by Government were all ready, but owing to delays on the part of the Municipality in financing their distribution it had not been started. The plant which was lying unutilised was acquired by the Military Department for use in Mesopotamia. This work will now have to be completed after the war when conditions are more favourable.

Allahabad Water-Works.—The three tube wells already sunk at Khusroobagh, Thornhill Road and Daragunj proved of the greatest service during the period of the breakdown at Karellabagh and enabled a certain amount of water to be pumped daily and so averted a complete water famine. Two more tube wells at the Polo Ground and Mayo Hall are being sunk.

Allahabad Kumbh Magh Mela.—A scheme for the supply of water to the pilgrims at the Mela was prepared and carried out. Owing to the high level of the river after the monsoon work could not be started on the mela ground until November 12th, 1917, but 27,500 feet of pipes varying in size from 10″ to 1½″ diameter were quickly laid and regular daily pumping from the tube well at Daragunj was started on 29th December, 1917. A continuous supply at the rate of about half a million gallons per day was given throughout the mela and pumping was finally stopped on the 4th March, 1918. The total cost of this work was about Rs. 56,000, but pipes and fittings to the value of about Rs. 37,000 are available for transfer elsewhere.

Bahraich.—The flushing scheme has been satisfactorily completed at a total cost of Rs. 51,212 and been handed over to the Municipal Board.

Aligarh.—No further progress has been made on completing the water-works scheme here. The tube wells and subsidiary buildings have been completed, but the installation of machinery and the distribution system has been postponed by Municipal Board till sometime after the end of the war. A scheme for generating current from the canal falls for lighting and power purposes is under preparation.

Khurja.—A scheme for a water-supply for Khurja and another for flushing the main drains only have been prepared and submitted to the Municipal Board. It is very doubtful if either of these schemes can be carried out at present. A proposal for a hydro-electric scheme with current generated at the canal falls for lighting and power purposes is also under consideration.

Tube wells.—A successful tube well has been sunk for the Military Works Department at Benares and work is in progress on another for the Military Works Department at Cawnpore. Work on tube wells for the East Indian Railway Company is also in hand at Cawnpore and Tundla.

ORIGINAL WORKS—DRAINAGE AND DRAINAGE SCHEMES.

Allahabad Drainage Works.—The expenditure during the year was Rs. 46,115, making a total of Rs. 7,28,226.

The distributing channel at the Sewage Farm has been lined as it was found that the earthen channel was frequently damaged owing to rat holes, etc. The Jumna Bridge pumping station was handed over to the Municipal Board on 8th April, 1917, and the plant has been working satisfactorily during the year, though there was slight trouble in the monsoons when the river was high through leaks in the gates of the storm water overflows, and this needs attention.

The main sewers forming part of the Allahabad drainage scheme already constructed by the Public Works Department have been maintained by them during the year, and they and the various street and house connections also recently constructed have all worked satisfactorily.

A scheme for the sewerage and drainage of the Kydgunj area in Allahabad has been prepared and sanctioned and funds allotted. The work will be put in hand shortly if the difficulty in arranging for bricks and materials can be got over.

Moradabad.—A project for improving the drainage of Moradabad has been sanctioned for Rs. 51,000 and funds allotted, and a flushing scheme for Rs. 1,13,000 has also been sanctioned and funds allotted; but it is doubtful if either of the above works can be taken up at present owing to the difficulties in getting materials at reasonable prices under present conditions.

Benares drainage.—The total expenditure during the year was Rs. 31,227 of which Rs. 8,214 was spent on the Bengali Tola lateral sewer and Rs. 14,013 on the Beni Madho Branch sewer.

Cawnpore.—The first three parts of the Cawnpore drainage scheme totalling to Rs. 24,99,518 have been completed and submitted to the Municipal Board. It is expected that the remaining parts nos. IV and V will be ready by June.

Two new Flexala pumps are on order for the Permit Ghat pumping station as the existing plant is incapable of dealing with the present flow of sewage which has been greatly increased by the large amount of war work being done in Cawnpore at the tanneries.

Meerut.—The anti-malarial scheme (lining of the Abu Nala) and the lining of the Surajkund have both been completed and handed over to the Municipal Board. The total expenditure has been Rs. 96,341 on the anti-malarial scheme and Rs. 12,450 on the tank lining.

A hydro-electric scheme for supplying current from the canal falls at Bhola for lights, fans and pumping a supply of water for Meerut is under preparation.

Saharanpur.—The anti-malarial work at Saharanpur consisting of relining of certain lengths of the Karegi and Chilkhana Nalas has been completed at a cost of Rs. 9,229 below the estimate.

A hydro-electric scheme for Saharanpur as well as schemes for water-supply and drainage are under consideration of the Municipal Board, but it is doubtful if anything can be done now till the war is over.

Landour (Mussoorie) drainage.—The progress of this work has been rather slow owing to difficulty in getting the necessary materials and labour, but the North Road tunnel and two latrines have been completed and progress has been made with the other works. The expenditure during the year was Rs. 31,359.

Agra drainage scheme.—The scheme amounting to Rs. 32,16,427 has been completed and accepted by the Municipal Board who have agreed to provide Rs. 35,000 annually towards carrying out the work.

Dehra Dun drainage.—The portion of the work in hand last year was successfully completed, but a further instalment consisting of the provision of a flushing scheme with pail dépôts water flushed latrines and an extension of the outfall on to a sullage farm is now being taken up from funds recently provided.

Public Works Department have spent the following sums on drainage works being carried out by them for Municipalities :—

Anupshahr, Rs. 2,269 ; Muttra, Rs. 4,334 ; Almora, Rs. 1,160 ; Farrukhabad, Rs. 872 ; Shahgunj, Rs. 300 ; and Ghazipur Rs. 805.

Of the three large drainage schemes in hand a year ago the Agra scheme has been completed and the Cawnpore and Bareilly schemes will be submitted complete in a short time. A list of other drainage and water-supply projects in hand is given in Appendix VIII of this report.

Increasing difficulty has been experienced in obtaining materials of all kinds, especially spare parts for the upkeep of machinery. New machinery is practically unobtainable.

The supply of coal for pumping has also caused much anxiety at different times. Allahabad, Benares and Naini Tal have been within two or three days of shutting down. The situation is better at present, but needs to be carefully watched. Coal for brick-burning is so short that bricks can only be had in small quantities, and if matters continue as at present it is extremely likely that all work on new water-supplies and drainage will have to be shut down till some period after the war when things get normal again.

The staff, on the whole, have worked very well. My special thanks are due to Mr. Hoey, Mr. Platt, Mr. Knox and Mr. Beveridge for the valuable assistance they have given me.

NAINI TAL :
Dated the 18th June, 1918.

C. H. WEST,
Sanitary Engineer to Government,
United Provinces.

APPENDICES.

APPENDIX

Statement of opera-

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
Population.				
1. By Census of 1911, in Municipality	163,935	159,701	199,868	173,973
2. ,, ,, ,, Cantonments	21,514	11,996	3,936	21,517
3. Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868	173,973
Consumption of water.				
4. During the year, including cantonments, Gallons.	1,280,804,000	1,089,682,975	1,779,693,432	1,845,260,000
5. Daily average, including cantonments. ,,	3,509,052	2,985,433	4,875,872	5,055,507
6. Maximum daily average in any one month. ,,	3,848,520	5,009,767	6,781,685	5,686,774
7. Water used for irrigation and manufacturing purposes. ,,	153,728,342	209,135,437	21,996,000	329,242,000
8. Water used for domestic purposes. ,,	1,127,075,658	880,547,538	1,757,697,432	1,416,018,000
9. Consumption per head for domestic purposes. ,,	16·65	14·05	24·09	22·30
10. Consumption per head for trade. ,,	2·27	3·33	·30	5·20
Total ... ,,	18·92	17·38	24·39	27·50
11. Daily average for Cantonments alone. ,,	245,421	146,065	2,431	13,891
12. Number of house connections during 1917-18.	26	37	173	267
13. Number of metered connections ...	120	366	6 house meters 35 district meters	61
Annual Receipts and Charges.				
14. Maintenance charges... Rs.	97,255	1,26,322	1,60,054	1,64,016
15. Cost per 1,000 gallons consumed...	1·21 annas	1·85 annas	1·44 annas	1·42 annas
16. ,, ,, ,, per 100 feet lift	·66 ,,	1·08 ,,	·90 ,,	·90 ,,
17. Cost of water per 1,000 gallons, including interest and sinking fund charges.	2·60 ,,	3·62 ,,	2·9 ,,	2·25 ,,
Lift of Pump.				
18. From river to settling tanks ...	45 feet	94 feet	88·15 feet	91·1 feet
19. From filtered water pumps to town distribution.	138·8 feet	76 ,,	72·55 ,,	65·6 ,,
Total Lift ...	183·8 feet	170 ,,	160·70 ,,	156·7 ,,
Income from Water-Works.				
20. Water rate recovered during the year. Rs.	1,03,517	1,02,211	1,16,431	1,52,473
21. Sale of water and other receipts Rs.	45,311	34,530	7,449	1,02,312
Total income Rs.	1,48,828	1,36,741	1,23,880	2,54,785

No. I.

tions during the year 1917-18.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
240,016	76,351	11,985	16,788	30,301	58,236	55,304	54,332
19,782	39,876	2,511	1,239	...	11,930	Nil	3,581
177,935	116,227	11,000	18,027	30,301	25,000	38,400	54,332
385,822,000	437,135,695	45,723,171	22,781,886	65,910,240*	†35,292,648	140,278,331	*54,143,000
2,426,909	1,197,63	125,269	62,416	180,576*	96,692	384,324	202,782
3,580,645	1,775,257	160,214	137,528	180,576	104,219	427,740	235,814
72,727,900	10,463,600	Nil	209,980	Nil	599,344	16,663,63	Nil
313,094,100	426,672,095	45,723,171	22,571,906	65,910,240	34,693,304	123,614,695	54,143,000
12·4	10·02	11·39	3·43	5·95	3·80	8·81	3·74
1·12	·25	Nil	·03	Nil	·06	1·18	Nil
13·52	10·27	11·39	3·46	5·95	3·86	9·99	3·74
178,877	525,569	628	3,552	Nil	Nil	Nil	Nil
80	54	334	242	Nil	10	30	Nil
292	34	335	238	Nil	3	199	Nil
1,47,030	Rs. 278 10	Rs. 23,085	Rs. 40,866	Rs. 3,382	Rs. 9,717	Rs. 11,330	Rs. 10,886
2·65 annas	1·02 annas	8·08 annas	Rs. 1·79	·82 annas	4·40 annas	1·28 annas	3·21 annas
1·45 ,,	·70 annas	·57 annas	Rs. ·26	...	2·96 annas	Nil	2·32 ,,
4·34 ,,	2·60 annas	Rs. 1·96	Rs. 2·80	...	5·72 annas	2·5 annas	6·45 ,,
113·9 feet	15·16 feet	Nil	Nil	...	.....	Gravitation scheme.	...
67·9 ,,	129·87 ,,	main pump 1,700′ auxiliary 600′	Tonnochy 1,160′ Ayarpatta 1,093′ Inter Cheena 450′ Inter Ayarpatta. 400′ Pilgrim 240′	...	148·74′	...	...
181·8′	145·03′			...	148·74′	..	134·98′
40,379	...	Rs 37,679	Rs. 30,108	...	Rs. 6,288	Nil	Rs. 18,290
82,195	Rs. 53,690	Rs. 5,678	,, 12,575	2,729	Rs. 686	14,084	Nil
1,22,574	Rs. 53,690	43,357	,, 42,683	2,729	Rs. 6,974	14,084	Rs. 18,290

* Excluding Cantonments.

† From 10th July, 1917 to 31st March, 1918.

APPENDIX No. II.

Annual maintenance accounts of water-works in the United Provinces during the year 1917-18.

Name of charges.	Agra	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
1. *Establishment*.—	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(*a*) Permanent establishment.	22,507	24,466	33,656	31,467	27,611	12,344	13,206	10,460	2,330	1,453	2,826	7,060
(*b*) Office contingencies.	1,324	246	1,005	1,085	678	5,772	847	306	...	161	3,791	264
(*c*) Rent ...	302	1,520	270	...	430	60	...	...	...	...	...	...
2. *Pumping*.—												
(*a*) Coal ...	40,696	44,557	61,167	53,456	70,567	531	...	21,811	...	4,392	...	...
(*b*) Oil and waste	5,182	5,044	7,408	8,500	4,905	582	2,084	517	...	273	...	3,060
(*c*) Other stores	6,169	3,965	4,311	4,061	5,137	3,226	3,029	999	...	1,015	...	...
3. *Intake*.—												
(*a*) Training river.	...	...	7	927	...	...	...	...	...	1,284	...	...
(*b*) Cleaning channels and wells.	3,837	473	1	62	...	50	...	...	...	...	...	...
4. *Settling tanks and filters*.—												
(*a*) Clearing settling tanks.	1,066	1,949	2,617	1,485	9,727	50	...	...	...	...	...	...
(*b*) Clearing and renewing filter beds.	1,492	1,691	1,585	7,353	649	1,292	...	...	...	...	...	...
(*c*) Purchase of sand.	9,559	3,479	3,933	4,906	8,486	...	...	...	...	...	...	...
(*d*) Purchase of alumino-ferric.	...	...	8,041	10,292	...	1,112	...	...	...	...	...	...
5. *Distribution*.—												
(*a*) Pipes and fittings.	1,018	3,978	1,148	12,748	1,515	1,307	285	2,055	272	706	1,309	...
(*b*) Meters ...	860	2,673	...	8,620	337	...	79	587	...	4	2,824	...
6. *Repairs*.—												
(*a*) To tanks...	414	201	...	...	11	...	230	169	...	415	...	...
(*b*) To buildings and grounds.	502	1,742	1,281	2,098	2,964	822	654	931	750	12	...	204
(*c*) To machinery.	2,165	21,071	32,328	16,817	13,885	402	2,570	2,213	...	...	...	...
(*d*) To rising main.	...	...	1,285	...	...	...	...	...	...	...	...	...
7. *Water analysis*.—	72	1,034	11	189	128	170	101	818	30	2	580	298
Total ...	97,255	1,18,989	1,60,054	1,64,016	1,47,030	27,810	23,085	40,866	3,382	9,717	11,330	10,886

APPENDIX No. III.

Statement showing initial capital cost of subsequent extensions and improvements incurred on water works in the United Provinces to the end of 31st March, 1918.

Water works stations.	Initial capital cost.	Cost of subsequent extension.	Cost of extension during the year 1917-18.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,76,761	13,46,347	1,87,506	27,04,614
Allahabad	16,24,061	6,78,697	89,344	23,92,102
Benares	25,61,881	7,52,788	2,223	33,16,892
Cawnpore	14,44,570	10,15,716	5,729	24,66,015
Lucknow	15,15,736	7,50,968	68,617	23,35,321
Meerut	7,51,710	50,159	Nil.	8,01,869
Mussoorie	4,79,754	1,59,040	4,577	6,43,371
Naini Tal	2,47,000	3,88,723	23,237	6,58,960
Dehra Dun	97,241	79,514	1,339	1,78,094
Mirzapur	6,29.508	36,660	5,495	6,71,663
Jhansi	96,556	53,165	3,890	1,53,611
Muttra	4,95,924	...	...	4,95,924

APPENDIX No. IV.

Statement showing rate of filtration and results of water-works of the United Provinces during the year 1917-18.

Municipalities.	Rate of filtration in gallons per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.		
	Maximum	Minimum	Average.	Good	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.	Mechanical filter samples.
Agra ...	34·6	30·0	32·77	3	Nil.	3	69	3 2	21
Allahabad ...	37·2	6·2	34·10	1	Nil.	1	379	10	
Benares ...	50·0	12·5	39·10	2	Nil.	2	345	2	
Cawnpore ...	50·0	15·0	43·2	1	Nil.	1	285	7	
Lucknow ...	56·25	6·25	30·41	1	Nil.	1	173	3	
Meerut ...	34·0	12·5	30·14	4	Nil.	4	199	4	
Mussoorie ...	...	...	...	...	...	...	...	...	
Naini Tal ...	...	...	...	2	Nil.	2	...	...	

APPENDIX No. IV A.

Statement showing the use of filters at various water-works during the year 1917-18.

Municipalities.	Rate of filtration in gallons per square foot per day.		Rate of filter area always out of operation during the year.
	Average rate on total filtering area.	Average rate on area in operation (vide Appendix IV.)	
Agra	25·06	32·77	20·95 per cent.
Allahabad	24·87	34·10	27·70 ,,
Benares	30·47	39·10	22·80 ,,
Cawnpore	36·11	43·2	15·42 ,,
Lucknow	17·33	30·41	43·02 ,,
Meerut	19·96	30·14	32·78 ,,

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising mains, etc.

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
1. Consumption of water per capita in gallons per diem.	18·92	17·38	24·39	27·50
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868	173,973
3. Water used for irrigation and manufacturing purposes.	153,728,342	209,135,437	21,996,000	329,242,000
4. Power of pumps per hour in gallons at river.	2. Horizontal pumps each 28 H. P. Designed for 84,000 Maximum 96,000 Average 78,000 1. Worthington low duty pump. Designed for 120,000 Maximum 132,000 Average 102,000 2. Diesel Engine 55 H. P. Designed for 180 000 Maximum 228,000 Average 192,000	2. Beam Engines 102 H. P. Designed for 126,000 Maximum 154,961 Average 114,862 1. Triple Expansion Engine 120 H P. Designed for 192,000 Maximum 192,000 Average 156,250	2. Horizontal Engines each 120 H. P. Designed for 252,000 Maximmm 234,388 Average 176,423 1. Worthington high duty pumping engine 235 H. P. Designed for 500,000 Average 382,710	2. Engines each 86 H. P. Designed for 187,500 gallons. Maximum 187,500 Average 154,467 1. Engine 100 H. P. Designed for 217,500 Maximum 235,000 Average 208,580
5. Power of pumps per hour in gallons at filter.	2. Beam Engines each 100 H. P. Designed for 192,000 Maximum 200,000 Average 180,000 1. High duty Worthington 130 H. P. Designed for 150,000 Maximum 156,000 Average 144,000	2. Beam engines each 135 H. P. Designed for 223,300 Maximum 265,000 Average 188,453	4. Beam engines each of 120 H. P. Designed for 450,000 each set (2 engines) Maximum 357,458 Average 336,562	Two engines each 80 H. P. Designed for 187,500 Maximum 187,500 Average 171,180 One engine. Designed for 283,140 Maximum 338,238 Average 288,470
6. Number of rising mains ...	2	2	2	2
7. Length of rising mains ...	2·5 and 1·75 miles respectively.	3·8 miles	Old rising main 4,727′ New „ „ 4,100′	1·32 miles ...
8. Size of rising mains ...	28″ and 18″	20″	Both 24″	Each 20″ dia. ...
9. Number of settling tanks.	5	3	3	3
10. Size of settling tanks ...	Each 266′ × 151′	Each 280′ × 180′	403·5′ × 252·5′ × 15′	Each 355′ × 255′ ...
11. Capacity of settling tanks in gallons.	2,200,000	1 and 3=4,400,620 2=4,455,626	1 and 3=6,436,120 2=6,508,927	Each 3,000,000 ...

No. V.

[illegible] the water works of the United Provinces for 1917-18.

Lucknow.	Meerut.	Mussoorie	Naini Tal	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
13·42	10·27	11·39	3·46	5·95	3·86	9·99	3·74
177,935	136,227	11,000	18,027	30,301	25,000	38,400	54,332
72,727,900	10,463,600	Nil	209,980	...	599,344	16,663,636	Nil.
2 Engines of 130 H. P	One engine of 26 H. P.	(a) Main pump designed for 10,800.	Engine ...	...	2 Compound piston pumps each capable of discharging 13,200 gallons per hour.		
Designed for 187,500 Maximum 188,237. Average 178,517.	Two turbines 90 H. P. Designed for 72 000. Maximum 61,985. Average 37,037.	Average 10,900. Maximum not known. (b) Auxiliary pumps. Designed for 4,800. Average 5,000. Maximum not known.	Lake station Designed for 14,355. Three engines each 31 H. P No. 1 Engine, plunger 5′ 13,104 gallons. No. 2, Engine 3½″ 5,160 gallons. No. 3 Engine 3½″ 5,160.	... ...			2 Diezel of 100 H. P. crude oil engines and dynamos 2 Motor driven centrifugal pumps to deliver 60,000 gallons per hour. Actual discharge 81,000 gallons per hour.
3 Engines of 110 H. P.	Second lift pump driven by same power.	(a) Main pump (motor driven two designed for 150 H. P.)	...	...		...	
Designed for 187,500.	Designed for 66,000	(b) Auxiliary pump (motor driven) two designed for 23 H. P.	...				
Maximum not known	Maximum 50,611.						
Average 178,000.	Average 30,327.						
1	1	2	5	...	1	1 Gravitation main.	1
3·5 miles...	15″ main = 38,292′. 13″ main = 8,550′	Murray springs 6,000 feet. John Mackinnon springs 1,400′.	Ayarpatta ·43 miles. Tonnochy ·66 miles. Pilgrim ·34 miles. Inter Cheena ·49 miles. Inter Ayarpatta ·25 miles.		... 9″=3·65 miles.	5·73 miles.	1817 feet.
20″	13″ and 15″	Murray springs 5″. John Mackinnon springs 3½″	4″, 3½″, 3″, 4″, 5″.		...	12″ diameter	12″
3	3	...	...				
250′×200′×13·6′	100′×60′×11′	...	...				
each 4,000,000	5,28,000 each.	...	...				

Details of pumps, filters, tanks, reservoirs, rising mains, etc.

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
12. Number of filters ...	7 + 1 mechanical filter.	6	8	7
13. Size of filters ...	200′ × 100′	200′ × 100′	200′ × 100′ × 6′—4½″	200′ × 100′ ...
14. Number of C. W. reservoirs	3	2	2	2
15. Size of C. W. reservoirs	103′ × 105′ × 10′	Each 160′ × 103·3 × 12.′	178⅓′ × 148⅓′ × 12′	Each 135′ × 106 ⅔′ × 12′ deep.
16. Capacity of C. W. reservoir in gallons.	676,000 each	1,240,000 gallons each.	1,854,068	Each 9,53,300 gallons.
17. Number of service reservoirs or stand pipes.	3	1	1	2
18. Size of service reservoirs	1 66′ dia. × 11⅓′ deep. 2 20′ dia. × 50′ deep.	60′ dia. × 11′ deep	60′ dia. × 15′ deep	Balancing tanks 50′—6″ high × 36′ dia. 50′—6″ high × 40′ dia.
19. Capacity of service reservoirs.	1 438,000 2 200,000 each	194,000 gallons	265,000	Holds 318,087 and 392,700 gall. respectively.
20. Number of public standposts.	Four-tap standposts each ¾″ size ... 43 Two-tap standposts of ¾″ size ... 63 One-tap standposts ... 159	One-tap standposts ... 144 Two tap standposts ... 59 Four-tap standposts .. 80 Waste-not cocks 13 Push cocks ... 13 Wall boxes ... 7 Bib cocks of ¾″ 6	One-tap standposts ... 245 Two-tap standposts ... 108 Four-tap standposts ... 80	Four-tap standposts ... 90 Two-tap standposts ... 51 One-tap standposts ... 63 Tap stand-posts 46 Bathing platforms 5

No. V.

in the water works of the United Provinces for 1917—18 (concluded).

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.	Muttra.
7	4	...	Jewel filter 12′dia 1 chlorine plant.	...	...	...	...
200′×100′	150′×100′	...	...	...			
2	1	4	1		...	...	
Each 105′×107′×12′ deep.	48′×52½′×7′ deep.	2×(40′×25′×8′). 1×(30′×20′×8′). 1×(80′×24′×6′).	45′×40′×6′ at W. W. station.	...	...	...	
798,500 gallons each.	110,600	2 of 50,000 gallons each. 1 of 30,000 gallons 1 of 72,000 gallons	67,500	...	...	...	
1	2	20 Iron Service Tanks.	82 Small service reservoirs and 6 large service tanks.	25	1	1	2
66′×12′	each 25′×34′.	1. 10′×10′×4′. 4. 8′×8′×4′. 10. 8′×4′×4′. 5. 4′×4′×4′.	Small service tanks :— 32 of 3′×3′ 29 of 2′—3″×3′, 1 of 4′×3′, 3 of 4′×5′, and 17 square tanks 6′×8′×4′ Large Service tanks :— 1 of 36′×15′×9 5′. 2 of 22·5′×13·33′, 1 of 29·5′×15′×9·5′. 1 of 20′×10′, 1 of 18′×10′.	Service reservoirs holding 192,225 gallons.	40′×15′×8′.	200′×75′	32′ dia. and 20′ high each.
250,000	100,000 gallons.	1 of 2,500 gallons. 4 of 1,600 gallons. 10 of 800 gallons. 5 of 400 gallons.	Total capacity of small reservoirs 38,200 gallons. Total capacity of large service reserviors 185,874 gallons.	...	30,000 gallons.	208,446	100,000 gallons each.
One-tap 102 standposts Two tap standposts 228	One-tap standposts of ¾″ 40 Two-tap standposts of ½″ 90 Wall-fountains 3 Taps of ½″ 4	Two-tap standposts 32	stand-posts 27	15 tanks of G.I. sheets, different sizes holding 2,290 gallons, 18 standposts with 2 brass cocks and 4 standposts with one brass cock.	Service tank with 50 taps 1 Iron tanks with 6 taps each 7 Standposts with two taps each 10	One-tap stand posts ... 34 Two-tap stand posts ... 27 Four-tap standposts 9 Hydrants 111 Wash out, 7	Standposts 94 Standpipes 5

APPENDIX No. VI.

Detailed statement of the expenditure incurred on works of sanitary nature under supervision of the sanitary engineer during the year 1917-18.

No.	Name of places.	Water works (original and special repairs).	Water works (maintenance).	Drainage.	Other works.	Total.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	Agra	1,87,506	97,255	32,260	3,599	3,20,620
2	Allahabad ...	89,344	1,18,989	46,115	...	2,54,448
3	Benares ...	2,223	1,60,054	31,227	...	1,93,504
4	Cawnpore ...	5,729	1,64,016	...	...	1,69,745
5	Lucknow ...	68,617	1,47,030	97,666	...	3,13,313
6	Meerut ...	...	27,810	...	...	27,810
7	Mussoorie ...	4,577	23,085	31,359	...	59,021
8	Naini Tal ...	23,237	40,866	...	...	64,103
9	Dehra Dun ...	1,339	3,382	25,826	...	30,547
10	Jhansi ...	3,890	9,717	...	2,257	15,864
11	Mirzapur ...	5,495	11,330	...	...	16,825
12	Muttra ...	46,010	10,886	4,334	...	61,230
13	Fyzabad ...	40,107	...	...	...	40,107
14	Almora ...	2,390	...	1,160	...	3,550
15	Bahraich ...	...	...	25,607	...	25,607
16	Farrukhabad ...	...	...	872	11,745	12,617
17	Shahganj ...	...	...	300	...	300
18	Ghazipur ...	...	...	805	420	1,225
19	Etawah ...	3,788	...	...	...	3,788
20	Nimsar ...	883	...	...	...	883
21	Aligarh ...	2,976	...	...	...	2,976
22	Unao	237	...	...	...	237
	Total ...	4,88,348	8,14,420	2,97,531	18,021	16,18,320

APPENDIX No. VII.

Comparative statement of working expenses of waterworks schemes in the United Provinces for 1917-18.

Number.	Name of water works.	Class of work, gravitation or pumping.	Coal consumption per 1,000 feet gallons.	Price of coal per ton.	Total lift, including friction.	Percentage of charges for—			Average consumption in gallons per head per day.	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet gallons for pumping scheme.	Cost of maintenance per head of population.	Cost of coal per 1,000 feet gallons	Income per head of population.	Remarks.
						Establishment.	Coal.	Other charges.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Agra ...	Pumping	lbs. ·0295	Rs. a. p. 13 4 3	183·8 feet.	23·14	41·84	35·02	18·92	As. 1·21	As. ·0066	As. 8·39	As. ·0028	As. 12·84	
2	Allahabad ...	„	·0411	12 15 0	170·0 „	20·56	37·44	42·00	17·38	1·85	·0108	11·77	·0038	12·74	
3	Benares ...	„	·0407	11 0 0	160·7 „	21·03	38·21	40·76	24·39	1·44	·0090	12·56	·0032	9·72	
4	Cawnpore ...	„	·0326	12 7 0	156·7 „	19·18	32·59	48·23	27·50	1·42	·0090	13·42	·0029	20·85	
5	Lucknow ...	„	·0942	10 8 0	181·8 „	18·77	47·99	33·24	13·52	2·65	·0145	9·05	·00707	7·54	
6	Meerut ...	Turbines worked by water power.	...	...	145·03 „	44·38	1·91	53·71	10·27	1·02	·0076	3·82	·00013	7·89	
7	Mussoorie ...	Pumping ...	...	...	Main pump=1,700′ Auxiliary 600′	57·2	...	42·8	11·39	8·08	·0057	26·37	...	47·85	
8	Naini Tal ...	Pumping and gravitation.	·095	Coal at Rs. 32-3-11 Wood at Rs. 18 per 100 md.	Tonnochy 1,160′ Ayarpatta 1,093′ Inter Cheena 450′ Inter Ayarpatta 400′ Pilgrim 240′	25·59	53·37	21·04	4·46	28·7	·0416	35·85	·022	37·40	
9	Debra Dun ...	Gravitation		...	...	68·89	...	31·11	5·95	·82	...	1·78	...	1·44	
10	Jhansi ...	Pumping ...	·104	17 6 10	148·74 „	13·22	39·95	46·83	3·86	4·40	·026	2·21	·013	1·58	
11	Mirzapur ...	Gravitation	...	...	...	24·94	...	75·06	9·99	1·28	...	3·28	...	4·25	
12	Muttra ...	Pumping ...	·013*	Rs. a. p. Oil fuel 85 0 0	134·8 feet	65·00	*28·1	6·9	3·74	3·21	·0238	3·21	*·0079	5·4	*Fuel oil.

APPENDIX No. VIII.

List of projects finally sanctioned during the year 1917-18.

	Rs.
Almora Drainage and water supply improvements ...	74,869
Allahabad Kumbh Mela water supply	59,943
Allahabad Naini sullage farm Nallah bridge	8,214
Allahabad Naini sewage farm pucca lining to the distribution trough.	9,820
Allahabad Kardabagh suction tunnel	23,339
Benares cantonment tube well	4,544
Cawnpore cantonment tube well	9,183
Dehra Dun supplementary drainage scheme	55,826
Etawah tube well	12,932
Fatehgarh Central Jail tube well	2,667
Lucknow sullage farm (new)	2,75,512
Lucknow Ghasiarimandi sullage drain diversion	21,627
Lucknow Drainage of Balrampur Hospital	13,690
Moradabad drainage improvements	50,825
Tundla East Indian Railway tube well	5,484
	6,28,475

List of projects submitted but not sanctioned during the year 1917-18.

Agra city drainage scheme	32,16,427
Agra (Shahganj) drainage scheme	33,291
Agra water works intercepting drains	2,811
Allahabad Kydganj drainage scheme	2,91,279
Allahabad (Khusroo Bagh) tube well (supplementary) ...	2,718
Bahraich flushing scheme (revised)	51,870
Bharaich water supply (supplementary)	1,11,2 77
Benares tube well	1,00,270
Cawnpore sewerage and drainage scheme, part II ...	11,16,437
Ditto ditto part III ...	2,39,584
Cawnpore Agricultural College sanitation scheme ...	60,356
Cawnpore Punjab Tannery tube well	4,606
Do. E. I. R. tube well	5,529
Dehra Dun outfall extension and sewage farm	11,661
Fyzabad water supply project (revised) tube well ...	2,765
Ditto ditto (supplementary)	10,107
Firozabad tube well	13,264
Gola Tank improvements	84,972
Haldwani water supply improvements	63,090
Khurja drainage improvements	17,004
Khurja water supply and flushing scheme (revised) ...	1,42,401
Lucknow water supply (from tube well)	1,27,503
Landour Bazar (Mussoorie) drainage scheme (revised) ...	2,93,074
Moradabad flushing scheme	1,12,671
Nagina drainage improvement	6,768
Nimsar Tank improvements	1,45,566
Sardhana drainage	25,684
Type design of latrines for schools	842
Ditto of meat markets, for 6 stalls ...	2,940
Ditto ditto for 24 stalls	7,504
Ditto ditto for 48 stalls	18,393
	63,27,614

List of projects under preparation during 1917-18.

Agra Cantonment Drainage...	6,40,520
Agra Shahganj scheme for filling borrow pits	11,011
Amroha slaughter house	4,000
Bareilly slaughter house	20,000
Bareilly drainage and sewerage scheme	24,64,610
Brindaban water supply	3,00,000
Ballia rat-proof godown	28,000
Balrampore drainage	4,00,000
Budaun flushing scheme	46,000
Cawnpore Sewerage and Drainage projects, Parts IV and V	9,00,000
Dehra Dun Arhat Ghat drainage	15,347
Hapur flushing scheme	67,454
Jhansi water supply	15,00,000
Jaunpur flushing scheme	40,000
Kaimganj drainage	11,471
Kosi water supply	1,50,000
Kosi outfall drain	10,544
Khir Sagar Tank at Baldeo in Muttra	40,000
Mussoorie Landour Bazar Extension of Drainage outfall	10,271
Muttra sewage scheme	2,00,000
Muttra Pail dépôt	14,441
Muttra water supply (supplementary)	46,376
Muttra Drainage of standposts	17,000
Meerut Hydro-electric scheme	6,00,000
Mahoba water supply	60,000
Muzaffarnagar flushing scheme	50,000
Moradabad tube well	10,000
Naini Tal Hydro-electric scheme (revised)	5,50,000
Patti tank drainage scheme...	8,000
Ujhani drainage...	1,20,000
Unao water supply	1,27,463
Reinforced concrete pipe experiment	5,000
Total	84,67,508

TWENTY-SECOND ANNUAL REPORT

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SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31ST MARCH, 1917.

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PRINTED BY THE SUPERINTENDENT, GOVERNMENT PRESS, UNITED PROVINCES,
1917.

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Twenty-second annual report of the Sanitary Engineer to Government, United Provinces, Allahabad, for the year ending the 31st March, 1917.

Establishment.—The post of Sanitary Engineer was held by Mr. C. H. West throughout the year.

The following officers were employed in the Sanitary department under the Sanitary Engineer:—

(1) Mr. G. McC. Hoey, Executive Engineer, in charge of the 1st Sanitary circle, Saharanpur.

(2) Mr. S. E. Platt, Assistant Sanitary Engineer, in charge of the 2nd Sanitary circle, Allahabad.

(3) Mr. A. S. Knox, Assistant Sanitary Engineer, in charge of the 3rd Sanitary circle, Cawnpore.

(4) Mr. E. W. Beveridge, Executive Engineer, in charge of the Well Boring Operations Division, Cawnpore.

In addition to these there were three Assistant Engineers, six Assistant Engineers under training, one Upper Subordinate, four temporary Upper Subordinates, 31 Lower Subordinates, 30 Draftsmen, and the necessary clerical staff and work establishment.

Expenditure.—The sum of Rs. 16,12,210 was spent on original Sanitary Works under Sanitary Engineer's supervision, and Rs. 6,85,548 was spent on the maintenance and repairs to open water-works also under Sanitary Engineer's supervision, the total expenditure for the year being Rs. 22,97,758 as shown in Appendix VI of this report. This is exclusive of expenditure incurred in the preparation of schemes.

Project work.—The value of projects dealt with by the Sanitary branch amounted to Rs. 1,82,10,494. Of these, projects to the value of Rs. 35,85,606 were sanctioned and to the value of Rs. 31,15,885 were completed and submitted for sanction and the remainder to the value of Rs. 1,15,09,003 were still under preparation being partially finished.

Open water-works.—From analyses of the water supplied at the various open water-works made weekly it appears that the water supplied was uniformly of good quality.

At Naini Tal there was trouble during the summer owing to falling off in the supply from the springs which usually supply Naini Tal. Arrangements were made to supplement the supply by bringing in the Bara Nadi Springs and a special chlorine plant was put in to sterilize the water from these springs before being brought into use.

At Cawnpore certain modifications were made in the Puech Chabal System installed there to prevent choking during the rains and ensure an increased output. These steps proved entirely successful.

At Agra two mechanical filters were installed to increase the supply of filtered water there. These have now been working nearly a year and have proved most satisfactory.

Steps have been taken to supplement the water-supply at Benares, Allahabad, and Lucknow. At Benares two good tube wells have been constructed, but owing to difficulty in procuring machinery no benefit has been derived from them so far. So also in Allahabad three excellent wells have been put down, but the permanent plant to bring them into use cannot be procured at present. At Lucknow four tube wells have been put down yielding a moderately good supply and a temporary second-hand plant has been put in to bring them into use until more efficient plant is obtainable.

There has been some trouble with breakdowns of the machinery at the unfiltered stations at Allahabad and Lucknow. At Allahabad the trouble was primarily due to settlement in the suction tunnels, but this was intensified by the very unsatisfactory state in which the new flywheel engine was maintained and the inferior work turned out at the Khusrubagh workshops in carrying out the ordinary renewals on the beam engines which had only recently been completely overhauled. These defects have now been attended to and the Karelabagh tunnel for the flywheel engine is being rebuilt. At Lucknow, towards the close of the year, the large flywheel engine broke down due to the fact that the engine had been kept running continuously since it was obtained without any overhauling of any kind. The stand-by engine was out of commission at the same time owing to a settlement in the foundations and it was with great difficulty that a supply of water was maintained during the period. These defects have now received attention and the trouble at Lucknow has more or less been got over for the time being.

Messrs. James Simpson & Co. inspected and submitted their usual annual reports on the machinery at the various pumping stations.

The occurrence of serious breakdowns at these water-works stations which might easily be avoided by timely attention by water-works superintendents to the plant under their charge point to the urgent necessity there is of having a mechanical expert to keep these men up to the mark. A theoretical expert would be worse than useless. What is wanted is a thoroughly practical mechanical engineer with at least 15 years' experience of erecting and overhauling pumps and pumping machinery, who can immediately detect and have rectified any defects that are beginning to show either in the engines or the pumps before they reach the stage in which a serious breakdown may occur. He would also see to the economical running of the plant, as in many instances, notably at Lucknow and Allahabad, the machinery during the past year has for long periods been run at efficiencies 50 per cent. below what they should normally work at and the loss to the municipalities in fuel costs are very great. I trust before the next report comes to be written that Government will see their way to sanctioning a mechanical expert with sufficient qualifications for these provinces.

ORIGINAL WATER-WORKS CONSTRUCTION AND SCHEMES.

Agra water-works.—Satisfactory progress has been made in reorganizing the Agra water-supply. The whole of the main laying work is now practically completed and work has been started on the new reservoirs at St. John's and Tajganj. The work on St. John's reservoir has been very much delayed owing to difficulties in acquiring the site, but these difficulties have now been got over. The completion of this project is likely to be considerably delayed owing to the great difficulty experienced in getting new machinery at present without a priority certificate. Efforts are being made to obtain a certificate, but if they are unsuccessful this work will have to wait till the end of the war. The total amount of the estimate is Rs. 10,55,035; total expenditure up to date is Rs. 5,39,674 and the total expenditure for the year Rs. 3,64,676. This work is being carried out by the Sanitary Engineer's staff and is directly under Mr. Hoey, Executive Engineer, 1st Sanitary circle, Saharanpur.

Muttra water-works.—This work has now been completed and the water-supply is ready to be started. The supply is drawn from four tube wells about 500′ apart connected by suctions to a central sump in which are placed two motor-driven pumps capable of delivering 1,000 gallons per minute against 157′ head by Mather and Platt, Limited. The power is supplied by two 100 H. P. Diesel engines by Mirlees Bickerton and Day coupled to 440-volt generators by Mather and Platt. The tests made on this plant were very satisfactory and gave excellent efficiencies and results. The tube wells and suction tunnels were constructed by Mr. E. W. Beveridge, Executive Engineer, Well Boring Operations Division, Cawnpore. The Sanitary Engineer's department also supervised the erection of the plant by the contractors. The main laying and erection of the balancing tanks was done by Martin & Co. under Public Works department supervision. The Public Works department also erected the pumping station buildings. The total estimate amounts to Rs. 4,83,724, the amount expended up to date being Rs. 4,52,083 and the amount expended during the year was Rs. 2,03,432. There are some liabilities still to be met and it is feared there will be some slight excess on the estimate for this work. This is the first of the many tube well installations projected in these provinces which has been finally completed and it will be interesting to watch the results in working.

Fyzabad and Ajudhia water-works.—This is a similiar installation to Muttra described above except that the supply will be 1,500 gallons per minute against 1,000 gallons per minute at Muttra. The pumping station, wells and suction pipes are completed and the machinery, which is by the same contractor as at Muttra, is under erection but the municipality has so far not financed the full cost of the scheme and no mains have been ordered. It is a pity that the work should be allowed to remain in the unfinished state. It is high time steps were taken to complete the work. The estimated cost of the Fyzabad and Ajudhia water-supply is Rs. 6,88,908 and of the new suction tunnels Rs. 39,489. The total expenditure up to date is Rs. 1,91,150 and the expenditure for the year Rs. 1,06,492.

Aligarh water-works.—This is a similar project to Muttra and Fyzabad. The supply from four tube wells will be 1,500 gallons per minute. The tube wells suction tunnels, and most of the pumping station buildings are complete, but work has been stopped as the municipality has decided not to proceed with the work during the period of the war. The total of the estimate is Rs. 6,64,186; the expenditure up to date is Rs. 93,992, and the expenditure for the year Rs. 46,282. The work was carried out by Mr. E. W. Beveridge, Executive Engineer, Well Boring Operations Division, Cawnpore.

Allahabad water-works.—A scheme for supplementing the Allahabad water-supply amounting to Rs. 2,64,991 was put in hand and an expenditure of Rs. 25,560 incurred. Two tube wells at Thornhill Road and Daraganj were completed and gave excellent results; a third one at the Polo Ground is in hand and the fourth one in Mayo Road has not yet been started. An additional well at Khusrubagh is completed. Expenditure during the year was Rs. 3,514. The suction tunnel of the new flywheel engine at Karelabagh, which was so badly damaged during last year's floods, is being rebuilt on a new design. The estimate amounted to Rs. 23,339 and the expenditure for the year was Rs. 4,833.

Hardwar water-works.—The Kumbh *mela* water-supply work, amounting to Rs. 1,62,617 which was in hand in 1915-16, was continued during the year and an expenditure of Rs. 41,827 incurred, but it was not finally completed for want of funds. An estimate for putting in permanent pumping plant amounting to Rs. 83,842 in place of the temporary plant was sent to the municipality but has not been finally disposed of by them.

Lucknow water-works.—At Lucknow the sinking of four tube wells for supplementing the water-supply was completed and an expenditure of Rs. 51,928 incurred. Owing to the difficulty in getting new machinery a temporary second-hand air lift plant with the necessary air lines and delivery pipes has been installed to carry on with till permanent plant is available.

Benares water-works.—At Benares two tube wells have been sunk to supplement the water-supply but owing to a difference of 20′ in the contaminated sub-soil percolation level and the level of the water in the tube wells air lift plant is required to lift the water to the clear water reservoir. So far we have been unable to procure the necessary plant and the wells have not been brought into use. An expenditure of Rs. 38,896 has been incurred.

Bahraich.—A tube well has been sunk for water-supply and flushing purposes and an engine and pump installed. A sum of Rs. 22,325 has been spent on the flushing scheme and further expenditure is contemplated to make the water available for drinking purposes.

Jhansi water-works.—The Jhansi municipality spent a sum of Rs. 30,569 in putting in new boilers and pumps at the Pahuj reservoir and in altering the size of the rising main from Dattia Gate to the city reservoir from 6″ to 9″ and in otherwise improving their mains. A scheme for a combined water-supply for the municipality, railway and cantonment from the Gurari river, a tributary of the Betwa, was drawn out costing about 15 lakhs and is under consideration. This is an alternative scheme to that drawn out last year from Ghamroha on the Pahuj river. No decision as regards adopting it has been arrived at yet.

Mussoorie water-works.—The municipality spent Rs. 13,015 in remodelling the main water-supply pumps. This work is now completed and is absolutely satisfactory both from the electrical and mechanical point of view.

Naini Tal water-works.—The municipality spent Rs. 13,389 on their water-supply. The intermediate level water-supply pipe line was partially laid and two new reservoirs put in. They were unable to complete this useful work during the year for want of funds. These funds have now been obtained and it is hoped this work will be completed during the year. The installation of a chlorine sterilization plant for the Bara Nadi Springs was also completed and should prove very useful in years of deficient rainfall.

Etawah and Gola Gokaran Nath.—Successful tube wells were sunk at Etawah and Gola Gokaran Nath costing Rs. 9,123 and Rs. 8,008 respectively and water-supply and flushing schemes are in hand.

Cawnpore water-works.—A sum of Rs. 15,744 was spent on original water-works, of which Rs. 11,415 was on extension of the mains. A scheme for a supply of water from the Canal to the Filtered Station, Cawnpore, was prepared costing Rs. 5,85,580 for the municipal board, but no action has been taken on this scheme yet as the river has again shifted its course and is now opposite the pumping station at Cawnpore. A trial tube well was also sunk on the Unao bank of the Ganges at Cawnpore and yielded 29,500 gallons an hour and a sketch project was drawn out for a supply of water to Cawnpore from this site, but the fair project has not been drawn out, pending a prolonged test to be made on the site to gauge the supply likely to be obtained from continuous pumping.

Among other important water-supply schemes prepared and under consideration the following may be mentioned: a water-supply and hydro-electric scheme for Saharanpur costing Rs. 3,18,071 and Rs. 3,00,000 respectively at present under consideration of the municipal board. A hydro-electric and pumping scheme for Naini Tal costing Rs. 4,44,597, at present being considered by Government. A hydro-electric and tube water-supply scheme for Meerut; a sketch project only has been prepared for this and the fair project will be taken up as soon as the Government Electrical Inspector can find time to look into this. A few other water-supply schemes in hand are detailed in the list of projects, Appendix VIII.

Drainage works and schemes.

Allahabad drainage works.—This scheme was originally sanctioned for Rs. 15,66,756. The sections dealing with the Allahabad city drainage were put in hand and all mains and sub-mains and the pumping station and plant and the sewage farm across the Jumna have now been completed. Most of the block-drainage in the city still remains to be done. Revised estimates for the portions taken up have been submitted and sanctioned. The expenditure for the year amounted to Rs. 1,07,315 and the total expenditure up to date comes to about eight lakhs. For pumping the sewage across the Jumna three sets of two-cylinder Diesel engines by Carel Frères, Ghent, have been installed. These are 130 B. H. P. each and they are direct coupled to two-chamber Worthington centrifugal pumps each capable of discharging 2,800 gallons per minute of sullage at 86′ head to the sewage farm when the chambers are in series or they can discharge 5,600 gallons per minute of storm water into the Jumna river at 45′ head when the pump chambers discharge in parallel. The installation put in by James Simpson & Co. was tested and found most satisfactory.

Lucknow drainage works.—At Lucknow a sum of Rs. 1,19,838 was spent on the new sullage farm across the Gumti river, a sum of Rs. 17,180 on the Ganeshganj market, and Rs. 2,042 on drains in the model house area.

Benares drainage works.—At Benares Rs. 46,802 was spent on the Bengali Tola drains which are practically completed. A sum of Rs. 7,156 was spent on completing and extending the Ghat sewer recently constructed and a further sum of Rs. 1,196 on drains in the *pakka* mahal area which practically completes the work in this area.

Cawnpore darinage works.—A sum of Rs. 32,630 was spent on paving lanes, Rs. 11,896 on the lining of the Sisamau Nala, Rs. 15,008 on minor sewer connections, and Rs. 3,303 on the paved footpath to Sarsayaghat.

The main drainage scheme for Cawnpore sewerage and drainage is now practically completed, the total cost being over 20 lakhs. Parts I and III aggregating about 15 lakhs have been completed and submitted to the Board for approval.

Meerut.—A further sum of Rs. 56,965 was spent on the anti-malarial scheme and lining of the Abu Nala. This scheme amounts to Rs. 1,07,795. This work would have been completed this year, but has been delayed owing to frequent flushes in the canal. About Rs. 25,000 still remains to be spent. The following sums were spent by Mr. Hoey on minor drainage schemes in his division: Debra Dun Rs. 11,921 and Landour Bazar, Mussoorie, Rs. 9,134. The Agra municipality spent Rs. 17,931 during the year in lane-paving and surface drains. The following sums were expended by the Public Works department on the drainage schemes being carried out by them for municipalities:—Muttra Rs. 35,358, Dhampur Rs. 22,120, Pilibhit Rs. 18,100, Bahraich Rs. 13,631, Jaunpur Rs. 6,214, Fyzabad Rs. 3,092, and Khekra, Rs. 1,556. There is nothing of special importance to note on these works.

The large detailed drainage and sewerage scheme for Agra city amounting to nearly 30 lakhs is practically completed and is being faired out and will be submitted shortly. The scheme for Bareilly amounting to Rs. 16,00,000 is also being faired out and will be submitted shortly. A scheme for the drainage and sewerage of Saharanpur amounting to Rs. 7,45,219 has been completed and submitted to the Municipal Board, Saharanpur.

A list of the other drainage projects in hand and submitted are given in Appendix VIII of this report. They are too numerous to refer to in detail in this report.

General remarks.—During the year under report great difficulties have been experienced in getting materials for the execution of work or repairs and also in obtaining quotations for the supply and delivery of materials and plant. Prices have varied so considerably that great trouble has been experienced both in estimating and carrying out works. The supply of coal for pumping has also caused grave anxiety at times.

In spite of these adverse conditions steady progress has been made in preparation of estimates and execution of works throughout the year. The water supply, except in two instances of breakdowns already mentioned, has been well maintained.

In conclusion, I want to thank the staff under me, Mr. Hoey, Executive Engineer, Mr. Beveridge, Executive Engineer, Mr. Knox and Mr. Platt, Assistant Sanitary Engineers, for the good work done by them. The staff of Assistant Engineers, subordinates and draftsmen under them, including the clerical staff have, with one or two exceptions, also done good work. It is invidious to draw distinctions when all have done well, but Mr. Hoey's project work is specially noticeable and Mr. Platt, who has had double duties to perform as an Assistant in charge of a project circle and personal assistant to the Sanitary Engineer, has been of great assistance to me throughout the year.

C. H. WEST,
Sanitary Engineer to Government, U. P.

DATED NAINI TAL:
The 27th June, 1917.

APPENDICES.

APPENDIX

Statement of operations

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
Population.				
1. By Census of 1911, in Municipality	163,935	159,701	199,868	173,973
2. ,, ,, ,, Cantonments	21,514	11,996	3,936	21,517
3. Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868	173,973
Consumption of water.				
4. During the year, including cantonments. Gallons.	1,333,955,800	1,171,973,332	1,802,594,037	1,866,230,474
5. Daily average, including cantonments. ,,	3,654,673	3,210,885	4,938,613	5,112,960
6. Maximum daily average in any one month. ,,	3,924,597	4,278,620	7,216,287	13,048,185
7. Water used for irrigation and manufacturing purposes. ,,	212,835,850	196,422,209	13,467,000	326,681,156
8. Water used for domestic purposes. ,,	1,121,119,950	975,551,123	1,789,127,037	1,539,549,318
9. Consumption per head for domestic purposes. ,,	16·56	15·5	24·5	24·2
10. Consumption per head for trade. ,,	3·14	3·1	·18	5·1
Total ... ,,	19·70	18·6	24·68	29·3
12. Daily average for Cantonments alone. ,,	243,270	140,036	2,283	20,987
13. Number of house connections during 1916-17.	74	113	220	347
14. Number of metered connections ...	107	370	6	68
Annual Receipts and Charges.				
15. Maintenance charges ... Rs.	86,383	1,13,764	1,22,013	Rs. 1,46,131
16. Cost per 1,000 gallons consumed ...	1·04 annas	1·55 annas	1·08 annas	1·25 annas
17. ,, ,, ,, per 100 feet lift	·541 ,,	·91 ,,	·66 ,,	·811 ,,
18. Cost of water per 1,000 gallons, including interest and sinking fund charges.	2·31 ,,	3·18 ,,	~~1·19~~ ,, 1·91	2·07 ,,
Lift of Pump.				
19. From river to settling tanks ...	45 feet	94 feet	88·62 feet	87·6 feet
20. From filtered water pumps to town distribution.	147 ,,	76 ,,	74·86 ,,	66·5 ,,
Total Lift ...	192 feet	170 feet	163·48	154·1 ,,
Income from Water-Works.				
21. Water rate recovered during the year. Rs.	95,909	1,21,164	Rs. 1,37,393	Rs. 1,44,424
22. Sale of water and other receipts Rs.	40,392	51,596	,, 6,606	,, 1,07,334
Total income... Rs.	1,36,301	1,72,760	,, 1,43,999	,, 2,51,758

No. 1.

during the year 1916-17.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Dehra Dun.	Jhansi.	Mirzapur.
240,016	76,351	11,985	16,788	30,301	58,236	55,304
19,782	39,876	2,511	1,239	...	11,930	...
259,798	116,227	11,000	18,027	30,301	25,000	38,400
1,019,395,000	433,212,511	46,311,261	26,583,815	65,910,240	38,713,050	118,580,981
2,792,863	1,186,884	126,880	72,832	180,576	106,063	324,879
3,544,838	1,759,693	176,690	156,873	180,576	198,137	418,750
156,912,000	9,981,620	Nil	326,111	Nil	1,014,339	...
862,483,000	423,230,891	46,311,261	26,257,704	65,910,240	37,698,711	...
9·09	9·97	11·53	3·99	5·95	4·13	8·47
1·66	·24	Nil	·05	Nil	·11	Nil
10·75	10·21	11·53	4·04	5·95	4·24	8·47
212,767	450,949	979	4,628	Nil	Nil	...
4,625	94	309	240	...	7	121
341	35	310	238	14	3	121
Rs. 98,595	Rs. 30,466	Rs. 24,578	Rs. 40,892	Rs. 3,196	Rs. 8,629	Rs. 10,901
1·54 annas	1·125 annas	8·5 annas	,, 1·54	·78	3·56 annas	1·47 annas.
·87 ,,	·84 ,,	·73 ,,	,, ·23	...	1·38 ,,	...
3·02 ,,	2·72 ,,	Rs. 1·25	,, 2·4	...	4·77 ,,	4·57 annas.
117·0 feet	15·16 feet	Main pump 1,700	Nil	Nil	175·65 feet	...
58·6 ,,	119·18 ,,	Auxiliary 600	Tonnochy 1,160' Ayarpatta 1,093'	Nil	Nil	Gravitation scheme.
175·6 ,,	134·34 ,,	...	InterCheena 450' Pilgrim 240' Inter Ayarpatta. 400'	Nil	175·65	...
Rs. 51,863	Rs. 64,357	38,660	29,140	...	Rs. 7,147	Rs. 8,518
,, 1,09,088	...	6,765	15,264	Rs. 3,025	,, 532	...
Rs. 160,951	Rs. 64,357	45,425	44,404	Rs. 3,025	Rs. 7,679	Rs. 8,518

APPENDIX No. II.

Annual maintenance accounts of water-works in the United Provinces during 1916-17.

Name of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Mirzapur.	Dehra Dun	Jhansi.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs	Rs.	Rs.	Rs.
1. *Establishment.*—											
(*a*) Permanent establishment.	23,080	25,846	33,135	31,898	27,742	12,050	14,345	11,131	2,516	2,187	1,461
(*b*) Office contingencies.	1,242	424	1,471	720	490	5,609	703	141	4,021	425	113
(*c*) Rent ...	506	1,520	270	...	430	60	...	...	...	...	976
2. *Pumping.*—											
(*a*) Coal ...	30,139	36,299	40,466	61,982	44,222	500	...	21,181	...	...	5,161
(*b*) Oil and waste	4,369	5,859	5,601	4,564	2,494	596	2,539	537	...	...	162
(*c*) Other stores	4,610	3,925	5,482	2,480	3.515	3,968	3,604	1,104	...	...	145
3. *Intake.*—											
(*a*) Training river.	...	...	1	1,112	...	...	...	...	...	...	...
(*b*) Clearing channels and wells.	4,420	577	...	62	100	42	...	...	...	...	1
4. *Settling tanks and filters.*—											
(*a*) Clearing settling tanks.	541	363	1,158	959	8,275	51	...	...	...	...	...
(*b*) Clearing and renewing filter beds	4,264	1,524	1,801	9,452	456	2,802	...	10	...	...	...
(*c*) Purchase of sand.	6,391	...	4,697	2,864	5,414	1,300	...	...	...	...	...
(*d*) Purchase of alumino-ferric.	...	...	3,984	10,087	...	911	...	...	...	...	...
5. *Distribution.*—											
(*a*) Pipes and fittings.	1,462	*12,174	3,515	6,809	1,034	835	842	2,538	...	355	376
(*b*) Meters ...	1,004	2,700	...	5,539	922	...	659	768	4,204	...	56
6. *Repairs.*—											
(*a*) To tanks ...	261	220	81	...	140	449	417	60	...	...	4
(*b*) To buildings and grounds.	951	3,224	2,084	884	598	993	945	406	...	159	29
(*c*) To machinery.	2,916	17,922	18,242	6,514	2,356	160	415	2,338	...	...	144
(*d*) To rising mains.	...	...	24	...	...	...	...	...	...	...	...
7. *Water analysis.*—	137	1,187	1	205	407	140	109	678	160	70	1
Total ...	86,333	1,13,764	1,22,013	1,46,131	98,595	30,466	24,578	40,892	10,901	3,196	8,629

*This includes pipes and fittings of the value of Rs. 8,024 kept for sale to public.

APPENDIX No. III.

Statement showing initial capital cost of subsequent extensions and improvements incurred on water-works in the United Provinces to the end of 31st March, 1917.

Water-works stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extension during the year 1916-17.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	9,81,671	3,64,676	25,17,108
Allahabad	16,24,061	6,00,260	78,437	23,02,758
Benares	25,61,881	7,13,892	38,896	33,14,669
Cawnpore	14,44,570	9,99,972	15,744	24,60,286
Lucknow	15,15,736	7,01,711	51,928	22,69,375
Meerut	7,51,710	44,205	944	7,96,859
Mussoorie	4,79,754	1,25,166	13,015	6,17,935
Naini Tal	2,47,000	3,75,334	13,389	6,35,723
Dehra Dun	97,241	79,514	Nil	1,76,755
Mirzapur	6,29,508	36,660	Nil	6,66,168
Jhansi	96,556	14,596	30,569	1,41,721

APPENDIX No. IV.

Statement showing rate of filtration and results of water-works of the United Provinces during the year 1916-17.

Municipalities.	Rate of filtration in gallons per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.		
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.	Mechanical filter samples.
Agra ...	35	29	32·3	2	...	2	57	Nil	9
Allahabad ...	49·6	6·2	29·6	2	...	2	396	10	...
Benares ...	53·92	16·36	39·75	2	...	2	322	4	...
Cawnpore ...	59	5	40·8	2	...	2	293	2	...
Lucknow ...	50	6·25	28·5	1	...	1	330	4	...
Meerut ...	19	12·5	15·9	2	...	2	200	8	...
Mussoorie ...	...	...	...	...	...	...	...	...	...
Naini Tal ...	...	...	...	2	...	2	...	...	...

APPENDIX No. IV-A.

Statement showing the use of filters at various water-works during 1916-17.

Municipalities.	Rate of filtration in gallons per square foot per day.		Percentage of filter area always out of operation during the year.
	Average rate on total filtering area.	Average rate on area in operation. (See Appendix no. IV.)	
Agra	26·1 gallons per square foot.	32·3 gallons per square foot.	19·2 per cent.
Allahabad	26·7 "	29·6 "	9·8 "
Benares	30·8 "	39·75 "	22·6 "
Cawnpore	36·5 "	40·8 "	10·6 "
Lucknow	19·9 "	28·5 "	30·2 "

APPENDIX

Details of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
1. Consumption of water per capita *in gallons* per diem.	19·70	18·6	24·68	29·3
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868	173,973
3. Water used for irrigating and manufacturing purposes.	212,835,850	196,422,209	13,467,000	326,681,156
4. Power of pumps per hour in gallons at river.	2. Horizontal pumps each—28 H. P. Designed for 84,000 Maximum ... 96,000 Average ... 78,000 1. Worthington low duty pump— Designed for 120,000 Maximum ... 132,000 Average ... 102 000 2. Diesel Engines 55 H. P. Designed for 180,000 Maximum ... 228,000 Average ... 192,000	2. Beam Engines 102 H. P. Designed for 126,000 Maximum ... 154,961 Average ... 114,862 1. Triple Expansion Engine H. P 120. *Designed for 192,000* Maximum ... 192,000 Average ... 156,250	2. Horizontal Engines each 120 H. P. Designed for 252,000 Maximum ... 250,660 Average ... 231,066 1. Worthington high duty pumping engine *235 H. P. designed* for gallons 500,000.	Two Engines each—86 H. P. Designed for 187,500 gallons. Maximum 187,500 gallons. Average 154,467 gallons. One Engine—100 H. P. *Designed for 217,500* Maximum 235,800 Average 208,580
5. Power of pumps per hour in gallons at filter.	2. Beam engines each 100 H. P. Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1. High duty Worthington—130 H. P. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	2. Beam engines each 135 H. P. Designed for 223,300 Maximum ... 265,000 Average ... 188,453	4. Beam Engines each of 120 H. P. Designed for 450,000 each set (2 Engines) Maximum ... 450,000 Average ... 335,877	Two Engines each—80 H. P. Designed for 187,500 Maximum 187,500 Average 171,180 One Engine— Designed for 283,140 Maximum 338,238 Average 288,470
6. Number of rising mains.	2	2	2	2
7. Length of rising mains.	2·5 and 1·75 miles respectively.	3·8 miles	Old rising main 4,727′ New „ „ 4,100′	1·32 miles
8. Size of rising mains.	28″ and 18″	20″	Both 24″	Each 20″ dia.
9. Number of settling tanks.	5	3	3	3
10. Size of settling tanks.	Each 266′ × 151′	Each 280′ × 180′	403·5 × 252·5 × 15	Each 355′ × 255′
11. Capacity of settling tanks in gallons.	2,200,000	1 and 3=4,400,620 2=4,455,626	1 and 3=6,436,120. No. 2=6,508,927 gallons.	Each 3,000,000.
12. Number of filters.	7+1 Mechanical filter	6	8	7
13. Size of filters ...	Each 200′ × 100′	200′ × 100′	200′ × 100′ × 6′—4½″	200′ × 100′
14. Number of C. W. reservoirs.	3	2	2	2

No. V.

Mains, etc., in the water-works of the United Provinces for 1916-17.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Mirzapur.	Dehra Dun.	Jhansi.
10·7	10·21	11·5	4·03	8·47	5·95	4·3
259,798	116,227	11,000	18,027	33,400	30,301	25,000
156,912,000	9,981,620	Nil	326,111	Nil	Nil	1,014,339
3 Engines of 130 H. P.	One Engine of 26 H. P.	...	Engine H. P. ...	...	...	2 Duplicate steam direct acting Pumps having a capacity of 55,000 gallons each and 2 compound Piston Pumps each capable to discharge 13,200 gallons per hour.
Designed for 187,500.	Two Turbines 90 H. P.	...	Lake station ...	...	...	
Maximum 188,237	Designed for 72,000.	...	Designed for 14,355.	...	...	
Average 178,517	Maximum 61,985	...	...	...	...	
	Average 37,037	...	...	...	...	
		(a) Main pumps. Designed for 10,800. Average 10,900 Maximum not known.				
		(b) Auxiliary pumps. Designed for 4,800 Average 5,000 Maximum not known.	Three Engines each 31 H. P. Capacity 18,326			
Two Engines of 110 H. P.	Second lift pump driven by same power.	(a) Main pumps (motor driven) two designed for (150 H. P.).	...	...	...	
Designed for 187,500.	Designed for 66,000.		...	...	...	
Maximum not known.	Maximum 50,611	(b) Auxiliary pumps (motor driven) one designed for 23 H. P.	...	...	...	
Average 178,000	Average 30,327					
1	1	2	4	1 gravitation main		5
3·5 miles	15″ main=38,292′ 13″ main=8,550′	Murray Springs 6,000 ft. ... John Mackinnon Springs 1,400′	Ayarpatta ·93 miles. Toonochy ·66 miles. Pilgrim ·34 miles Lake ·19 ,,	... 5·73	8·5 6·3	9″=3·65 miles. 6″=0·70 ,, 6″=1·6 ,, 4″=3,040 feet. 3″=5,040 ,,
20″	13″ and 15″	Murray springs 5″ John Mackinnon Springs 3½″	4″, 3½″, 3″, 4″	12″	2½″, 3″	9″, 6″, 4″ 3″.
3	3	...	...	...	...	...
250′ × 200′	100′ × 60′ × 11′	...	...	...	...	...
Each 4,000,000	5,28,000 gallons each.				...	
7	4	...	1 Jewel filter 12′ dia.	...	...	...
200′ × 100′	150′ × 100′	...		...	...	...
2	1	4	5 1 chlorine plant	...	...	...

APPENDIX

Details of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
15. Size of C. W. reservoirs	103′ ×105′ ×10′	Each 160′ × 103·3 ×12	178½×148⅓′×11½′	Each 135′×106⅔′—×12′ deep.
16. Capacity of C. W. reservoir in gallons.	676,000 each	1,240,000 each	1,905,000 each	Each 953,300 gallons.
17. Number of service reservoirs or stand pipes.	3	1	1	2
18. Size of service reservoir	One 66′ dia.× 11⅓′ deep. Two 20′ dia. ×50′ deep.	60′ dia.× 11′ deep	60′ dia.×15′ deep	Balancing tanks 2 50′—6″ high ×36′ dia. 50′—6″ high ×40′ dia. Holds 318,087 gallons.
19. Capacity of service reservoir.	One 438,000 two 200,000 each.	194,000	265,000	392,700 gallons.
20. Number of public stand-posts.	43 four-tap stand-posts each ¾″ size; 62 two-tap stand-posts of ½″ size; 156 one-tap stand-posts.	One-tap stand-posts ... 144 Two-tap stand-posts ... 59 Four-tap stand-posts ... 80 Waste not cocks 13 Push cocks ... 13 Wall boxes ... 7 Bib cocks of ¾″ size ... 6	One-tap stand-posts ... 244 Two-tap stand-posts ... 108 Four-tap stand-posts ... 80	92 four-tap stand-posts. 52 two-tap stand-posts. 64 one-tap stand-posts. 33 tap stand-posts 5 Bathing platforms

No. V.

Mains, etc., in the water-works of the United Provinces for 1916-17—(concluded).

Lucknow	Meerut.	Mussoorie.	Naini Tal.	Mirzapur.	Dehra Dun.	Jhansi.
Each 105′×107′×11′ 4″ deep.	48′×52½×7′ deep.	2×(40′×25×8′). 1×(30′×20′×8′). 1×(80×24×6).	... ...			
798,500 gallons each.	110,600	2 of 50,000 gallons each. 1 of 3,000 gallons. 1 of 7,200 gallons.				
2	2	20 Iron service tanks.	5	1	25	1
66′×12′	2—Each 25′×34′.	1. 10×10×4 4. 8×8×4 10. 8×4×4 5. 4×4×4	28 Round service tanks 3′×3′, 28 round service, tanks 2′—8″×3′, 18 square tanks 6′×8′×4′.	200′×75′	Service reservoirs holding 192,225 gallons.	40′×15′×8′
250,000 350,000	100,000 gallons each.	1 of 2,500 gallons. 4 of 1,600 10 of 800 gallons. 5 of 400 gallons.	...	208,446		30,000 gallons.
201 one-tap stand-posts 228 two-tap stand-posts.	40 one-tap stand-posts of ¾″; 90 two-tap stand-posts of ¾″; 3 wall fountains; 4 taps of ½″.	32 two-tap stand-posts.	64 service tanks 27 stand-posts.	34 one-tap stand-posts. 27 two-tap stand-posts. 9 Four-tap stand-posts. Hydrants 111 washouts 7.	15 Tanks of G. I. sheets different sizes holding 2,290 gallons. 18 Stand-posts with 2 brass cocks 3 stand-posts of 1 tap.	1 Service tank with 50 taps. 7 Iron tanks with 6 taps each. 10 stand-posts with two taps each.

APPENDIX No. VI.

Detailed statement of the expenditure incurred on works of sanitary nature under supervision of the Sanitary Engineer during 1916 17.

No.	Name of places.	Water-works (original).	Water-works (maintenance).	Drainage.	Other works.	Total.
		Rs.	Rs.	Rs.	Rs.	Rs.
1	Agra	3,64,676	86,383	17,931	2,555	4,71,545
2	Allahabad ...	78,437	1,13,764	1,07,315	...	2,99,516
3	Benares ...	38,896	1,22,013	55,156	...	2,16,065
4	Cawnpore ...	15,744	1,46,131	62,837	...	2,24,712
5	Lucknow ...	51,928	98,595	1,39,060	1,124	2,90,707
6	Meerut... ...	944	30,466	56,965	130	88,505
7	Mussoorie ...	13,015	24,578	9,134	...	46,727
8	Naini Tal ...	13,389	40,892	...	...	54,281
9	Dehra Dun ...	Nil	3,196	11,921	...	15,117
10	Mirzapur ...	Nil	10,901	...	...	10,901
11	Jhansi	30,569	8,629	...	...	39,198
12	Dhampur ...	...	...	22,120	...	22,120
13	Muttra... ...	2,03,432	...	35,358	...	2,38,790
14	Hardwar ...	41,827	...	...	...	41,827
15	Khekra ...	...	...	1,556	...	1,556
16	Fyzabad ...	1,06,492	...	3,092	...	1,09,584
17	Bahraich ...	22,325	...	13,631	...	35,956
18	Pilibhit ...	...	...	18,100	...	18,100
19	Jaunpur ...	412	...	6,214	...	6,626
20	Aligarh ...	46,282	...	...	...	46,282
21	Etawah ...	9,123	...	...	...	9,123
22	Gola Gokarannath ...	8,008	...	...	...	8,008
23	Nimsar ...	1,497	...	...	...	1,497
24	Khurja... ...	537	...	...	...	537
25	Unao	179	...	...	...	179
26	Bindki... ...	...	...	...	299	299
	Total ...	10,47,712	6,85,548	5,60,390	4,108	22,97,758

APPENDIX No. VII.

Comparative statement of Working Expenses of Water Works Schemes in the United Provinces for 1916-17.

Number.	Name of water-works.	Class of work, gravitation or pumping.	Coal consumption per 1,000 feet gallons.	Price of coal per ton.	Total lift, including friction.	Percentage of charges for—			Average consumption in gallons per head per day.	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet gallons for pumping scheme.	Cost of maintenance per head of population.	Cost of coal per 1,000 feet gallons.	Income per head of population.	Remarks.
						Establishment.	Coal.	Other charges.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				Rs. a. p.						As.	As.	As.	As.	As.	
1	Agra ...	Pumping ...	·022 lb.	11 12 0	192 feet	26·7	34·9	38·4	19·70	1·04	·0054	7·45	·002	11·75	
2	Allahabad ...	„ ...	·0436 „	9 6 0	170 „	22·71	31·90	45·39	18·6	1·55	·0091	10·59	·0029	16·09	
3	Benares ...	„ ...	·0313 „	9 13 11	163·48′ feet	27·15	33·16	39·69	24·68	1·08	·0066	9·76	·0022	11·52	
4	Cawnpore ...	„ ...	·0477 „	10 2 0	154·1 „	21·82	42·42	35·76	29·3	1·25	·0081	13·44	·0034	23·15	
5	Lucknow ...	„ ...	·0473 „	11 12 0	175·6 „	28·13	44·85	27·02	10·75	1·54	·0087	6·072	·0039	9·91	
6	Meerut ...	Turbines worked by water power.	...	...	134·34 „	39·55	1·65	58·80	10·21	1·125	·0084	4·19	·0014	8·85	
7	Mussoorie ...	Pumping ...	...	...	Main pump=1,700′ Aux. „ 690′	58·36	...	41·64	11·53	8·5	·0073	2·23	...	Rs. 4·13	
8	Naini Tal ...	Pumping and gravitation.	·088 lb.	Coal at Rs. 30 Wood at Rs. 19 per 100 mds.	Tonnochy 1,160′ Ayarpatta 1,093′ Pilgrim 240′ Inter Cheena 450′ Inter Ayarpatta 400′	27·27	51·79	20·94	4·04	Rs. 1·54	·0023	2·26	·018	As. 2·46	
9	Mirzapur ...	Gravitation	...	...	...	23·07	...	76·93	8·47	As. 1·47	...	·284	...	·22	
10	Dehra Dun	„ ...	...	...	...	68·42	...	31·58	5·95	·77	...	·106	...	·099	
11	Jhansi ...	Pumping ...	·04 lb.	Rs. a. p. 13 8 2	175·65 feet	16·93	59·80	23·27	4·24	3·56	·024	·345	·0128	·308	

APPENDIX No. VIII.

Projects submitted and sanctioned during the year 1916-17.

	Rs.
Cawnpore Tube well	20,548
Do. Sisamau Nala	33,000
Do. Sarsaya Ghat sewer	15,100
Do. Collectorganj market improvement	2,52,100
Agra water-supply improvement	10,55,035
Aligarh Water-Supply	6,64,186
Allahabad unfiltered water-supply	2,64,991
Do. drainage staff quarters	38,331
Do. connecting certain drains to the sewerage system	1,723
Do. Khusrubagh tube well	15,519
Bahraich supplementary drainage scheme	55,018
Do. flushing scheme	35,567
Deoband flushing tank	1,787
Fyzabad water-supply	6,88,908
Do. new suction tunnel	39,489
Do. flushing scheme	16,103
Lucknow Hussainganj drain	26,945
Mussoorie Landour bazar drainage	2,73,191
Meerut anti-malarial scheme (cleaning Surajkund tank)	16,684
Pilibhit civil station drainage (revised)	17,463
Saharanpur anti-malarial scheme (Karegi and Chilkana drains)	27,566
Daraganj (Allahabad) tube well	12,461
Jaunpur trial boring	1,580
Etawah tube well (revised)	9,628
Gulab Bari (Fyzabad) tube well	2,683
	35,85,606

Projects submitted but not yet sanctioned.

Hardwar water-supply	83,842
Cawnpore drainage scheme, Part I	11,43,547
Almora water and drainage	74,869
Bareilly tube well	2,233
Fyzabad distillery tube well	2,101
Tube well, E. I. R., Cawnpore	9,776
Tube well, Benares cantonment	4,575
Benares water-supply tube well	1,00,270
Unao Bank water-supply, Cawnpore	5,08,214
Etawah water-supply	30,792
Beveridge tube well for Unao Bank	4,591
Saharanpur drainage	7,45,219
Saharanpur water-supply	3,18,071
Dehra Dun drainage supplementary	61,916
Agra hospital buildings	25,869
	31,15,885

APPENDIX No. VIII—*(concluded).*

Projects in hand.

	Rs.
Cawnpore drainage scheme no. III	2,20,547
Do. Canal water-supply	5,85,580
Agra electric supply	3,28,296
Naini Tal hydro-electric scheme	4,44,597
Machhlishahr drainage scheme	45,369
Meerut H. E. scheme	5,34,430
Saharanpur H. E. scheme	3,00,000
Cawnpore sewerage scheme, Part II	8,00,000
Jhansi water-supply	15,00,000
Cawnpore Agricultural College improvement	50,000
Agra Drainage	20,00,000
Rampur Act. XX Towns Drainage	20,000
Sardhana drainage...	20,000
Hapur drainage improvements	46,000
Do. flushing scheme	
Bareilly drainage and flushing schemes	16,30,000
Nagina drainage improvements	5,000
Gola Gokaran Nath improvements	1,70,000
Nimsar improvements	1,00,000
Kydganj drainage	2,74,624
Balrampur drainage	4,00,000
Kaimganj drainage	60,000
Moradabad flushing and water-supply	1,00,000
Do. drainage improvements	50,000
Haldwani water-supply	50,000
Budaun flushing scheme	50,000
Unao water-supply	1,00,000
Jaunpur water-supply and flushing scheme	3,50,000
Patti improvements	6,000
Shahganj flushing	10,000
Meat Market standard design	16,000
Slaughter house Amroha	4,000
Do. Bareilly	20,000
Brindaban water-supply	2,00,000
Khurja drainage improvements	8,000
Type design of latrine for schools and private buildings ...	1,000
Total ...	1,15,09,003

Twenty-first Annual Report

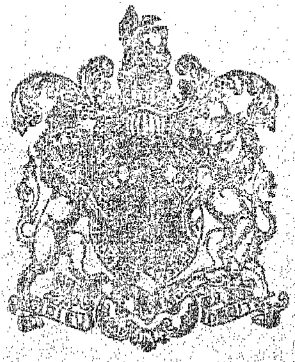
OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

For the year ending 31st March, 1916.



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Twenty-first annual report of the Sanitary Engineer to Government, United Provinces, Allahabad, for the year ending the 31st March, 1916.

THE post of Sanitary Engineer was held by Mr. C. H. West throughout the year.

Besides the eight water works stations at Agra, Allahabad, Benares, Cawnpore, Lucknow, Meerut, Mussoorie and Naini Tal, the following places were visited by the Sanitary Engineer during the year for the purposes of inspecting works or advising municipalities regarding sanitary schemes :—

Kathgodam, Bareilly, Hardwar, Saharanpur, Nagina, Moradabad, Muttra, Fyzabad, Unao, Khurja, Hapur, Dehra, Jhansi, Bahraich, Gorakhpur, Shahganj, Aligarh, Misrikh and Nimsar.

The Assistant Sanitary Engineers also visited the following places during the year :—

Benares. Bareilly, Khurja, Aligarh, Meerut, Muttra, Hardwar, Rurki, Jhansi, Tundla, Deoband, Hapur, Amroha, Haldwani, Kathgodam, Naini Tal, Pilibhit, Nagina, Moradabad, Lucknow, Mussoorie, Dehra Dun, Kanth and Agra.

The following officers were employed on the preparation of the sanitary projects :—

(1) Mr. G. McC. Hoey, Executive Engineer, I Sanitary division, Saharanpur.

(2) Mr. W. G. Morris, Assistant Sanitary Engineer, II circle, Allahabad, to January 1, 1916, on which date his services were placed at the disposal of the Military department.

(3) Mr. A. S. Knox, Assistant Sanitary Engineer, III circle, Cawnpore.

(4) Mr. S. E. Platt, Assistant Sanitary Engineer, worked at Saharanpur in the I Sanitary Divisional Office to the 30th November, 1915, after which he was transferred to head office at Allahabad as Personal Assistant to the Sanitary Engineer, and in addition, on January 1, 1916, he took over charge of the II circle from Mr. Morris.

Mr. Morris, in addition to project work, was also engaged in supervising the maintenance of open water works.

The following was the construction staff employed on sanitary works under the Buildings and Roads branch of the Public Works department :—

(1) Mr. H. J. Amoore, District Engineer, Muttra, was employed on the drainage and the water works at Muttra. He was assisted by Mr. Miles who has since left the department.

(2) Mr. C. F. Hunter, District Engineer, Allahabad, was employed on the drainage works at Allahabad.

(3) Mr. Sheoraj Bahadur, Assistant Engineer, was in charge of the Bahraich district and the drainage works at Bahraich. The drainage works have been completed as far as funds will permit. A revised flushing scheme has just been sanctioned and this will shortly be taken in hand.

(4) Mr. Otto, District Surveyor of Jaunpur, was employed on the drainage works at Shahganj. A sum of Rs. 36,000 has been spent out of a total estimate amounting to Rs. 69,818, as funds are exhausted the portion already constructed will shortly be made over to the notified area for maintenance.

Mr. Otto has also carried out the construction of a section of the drainage works at Jaunpur. About Rs. 53,602 were spent out of an estimate of Rs. 54,807 and the work is practically completed.

The District Surveyor of Fyzabad was engaged on the Fatehganj nala section of the drainage works at Fyzabad. This is now completed. About Rs. 3,500 were spent on miscellaneous works.

The District Surveyor of Bijnor was employed on the Dhampur drainage works. A sum of Rs. 12,036 was spent on this work in 1914-15 and a further expenditure of Rs. 18,421 has been incurred this year out of an allotment of Rs. 25,000 for the year.

During the year under report the following works were carried out by Mr. G. McC. Hoey, Executive Engineer, I Sanitary division.

Work was started on the Meerut anti-malarial scheme, estimated to cost Rs. 1,07,795. Progress was slow and the sum of Rs. 19,073 only was spent during the year. The work is progressing more satisfactorily now and will be completed shortly.

Work was also in hand on the Dehra Dun drainage scheme costing Rs. 73,267. The main sewer was completed and the work on flushing tanks is in hand. A sum of Rs. 26,143 was spent during the year.

The drain diversion at Islamia College, Deoband, was practically completed; Rs. 1,511 were spent. The estimated cost of the work was Rs. 2,097.

Hardwar water supply.—The water mains, the whole way from the percolation wells to "Har-ki-Pauri" with all standposts and connections were completed. The wells were also completed by the Boring division. Pilgrim tanks nos. 1 to 7, which were partially finished and used temporarily for the *Kumbh Mela*, still remain to be completed and certain other minor works also remain to be finished when funds are available. The expenditure for the year was Rs. 98,815 by the I Sanitary division, and Rs. 19,205 by the Boring division, making a total expenditure of Rs. 1,18,020 for the year against an estimate of Rs. 1,62,617. Full payments were not made as funds were not available. It is proposed now to complete this work with a permanent pumping installation, the power being obtained from the Ganges canal electric installation at Bahadurabad at an estimated cost of about Rs. 60,000.

In addition to the above a great deal of work was done by the larger municipalities, details of which are briefly given.

Agra water works.—Both the filtered and unfiltered supply engines were overhauled during the winter and all worn parts renewed. The high duty Worthington and Diesels worked excellently throughout the year.

A new economiser will shortly be put in.

The cold weather channel of the Jumna left the pumping station and kept to the opposite bank and an inlet canal had to be maintained at a great expense.

Detailed plans and estimates for the modification of the scheme proposed by the committee which sat in Agra in 1913 have been prepared and submitted to Government for sanction.

Work on the new water mains has already begun. About 1,000 tons of pipes were delivered and some 350 tons laid during the year. This work is being carried out under Mr. G. McC. Hoey, Executive Engineer, I Sanitary division. The total estimated cost of the work is Rs. 10,27,254 and Rs. 1,57,200 were spent during the year. Two mechanical filters of the Mather and Platt type have been received and are under erection. A new store godown has been built. Work on the engine house and storage tanks is in hand and the new machinery required has been ordered.

The drainage and sewerage scheme for Agra, which has been under preparation for some time, is nearly ready and will be submitted for sanction shortly.

The Agra sullage farm continues to be profitable, and though the area has been reduced by river encroachments, a profit of Rs. 7,800 was realized from it this year.

Allahabad water works.—At the unfiltered station at Allahabad both beam engines have been overhauled and the pumps lowered and put to work again. The new fly-wheel engine, which was taken over on June 16, 1914, and was allowed to get into disrepair, has also had to be thoroughly overhauled. The filters at Allahabad were not working satisfactorily as the layer of filtering sand was too thin. A sum of Rs. 10,000 has been spent in renewing the sand, the beds are now of the correct thickness and they are working much better.

Considerable difficulty has been experienced in turning out repairs quickly and accurately for Karellabagh pumping station from the filtered station workshop at Khusroobagh, so it is now proposed to erect a separate workshop at Karellabagh sufficient to keep pace with the work there. This is very necessary and should be done without delay.

The demand for water has continued to increase at Allahabad, and with a view to keep pace with it, an estimate for the supply of unfiltered water from tube wells at a cost of Rs. 2,37,030 has been prepared and submitted for sanction. A tube well on Thornhill Road has already been sunk and has proved very successful.

A second tube has been put down near the engine house at Khusroobagh and a very plentiful supply of water obtained.

A third tube well is being sunk at Daraganj for the local supply of Daraganj and with a view of meeting the periodical demands for water for pilgrims at the junction of the Jumna and Ganges.

Allahabad drainage works.—The progress on main drain no. 3 was delayed owing to the alignment being altered through a new road which was taken up by the municipality. This land has now been acquired and work is proceeding. It is anticipated that all sewer construction will be completed before the rains, and that the pumps will be in working order a month after the auxiliary electric plant is received. There has been some delay in delivering this plant for which the contractors, Messrs James Simpson and Company, are responsible. Money is still wanted for distribution channels at the sullage farm and for staff quarters and it is hoped everything will be finished before the close of the year.

Benares water works.—The Worthington high duty pumps which caused such serious trouble in August 1914 have been re-erected and the pumps have been lowered. They are reported to be working well; but the Westinghouse compressors are unsatisfactory and give trouble. A new rotary compressor has been ordered and is on the way out. Extensive repairs to the old Bhadaini engines are being carried out and will shortly be finished. The erection of two Babcock and Wilcox boilers at the filtered station has been completed and extensions of sub-mains have been carried out at several places in the city. A tube well boring put down in the compound of the filtered station has been very successful. A second well is being sunk and plans and estimates for the necessary pumping machinery are being prepared and a valuable subsidiary source of supply will soon be available.

The waste meter scheme was worked on a small scale and proved useful. The shortage of water is said to be mostly due to defective house fittings and these are being repaired as quickly as possible.

Benares drainage works.—The Orderly Bazar sewer has been nearly completed. A small portion is still left and will be taken in hand soon. The Man Mandir portion of the Pucca Mahal drains has been completed and the Bulwa nala area is in hand. The Gau Ghat intercepting sewer, which was completed in 1913 with an outfall at Gau Ghat, has now been extended to Trilochan Ghat.

Besides these several minor drainage works costing in all about Rs. 10,000 were also carried out in addition to many other sanitary improvements.

Cawnpore water works.—The pumping engines at both the filtered and unfiltered stations were carefully repaired and overhauled. There has been an increase in the consumption of filtered water chiefly for the mills. This has necessitated longer hours of pumping and practically a constant supply of water is now being given.

An estimate amounting to Rs. 61,493 for extending the water mains to various portions of the city and replacing smaller mains by larger ones in order to meet the increasing demand, is at present under consideration.

The cold weather stream of the Ganges is still on the opposite bank from that on which the pumping station is situated, and it is practically impossible to pump from the river now during the dry seasons except at prohibitive cost as there is a stretch of nearly two miles of sand between the pumping station and the river channel.

All the winter supply is at present being drawn from the Lower Ganges canal and a scheme is being drawn out for putting this on a more satisfactory basis.

Attempts were made to get a tube well supply near the filtered station at Cawnpore, but the results showed that only a limited supply could be got by these means and the strata met with up to a considerable depth over 400 feet from the surface consisted chiefly of clay and were only slightly water-bearing. An experimental tube well was sunk on the Unao bank near the railway bridge crossing on the line from Cawnpore to Lucknow and a good supply of water was obtained. A scheme for putting in a series of tube wells at this site is now under consideration. The Puech-Chabal filter installation was in use throughout the year. The amount of water passed through this installation during the rains fell short of the demands. Attempts are being made to increase the output and reduce the cost of upkeep of the plant.

The new waste-detecting meters were in regular use and frequent night inspections succeeded in considerably reducing the waste, but the principal loss is now said to be from latrines and flushing cocks many of which are kept open throughout the night. This is being attended to.

A scheme for supplying cantonments with water has been drawn up and submitted to the municipality.

Cawnpore drainage works.—The drainage and sewerage scheme for Cawnpore is nearing completion. The section dealing with the main portion of the city at a cost of about 11 lakhs is now being printed up and will be sent in for sanction at once. The remainder of the scheme which will probably cost 10 lakhs more is in hand and should be completed before very long.

Lucknow water works.—At the filtered water works station, Aish Bagh, a new Worthington high duty triple expansion engine was installed and it has now been taken over by the municipality. The old engines at Gau Ghat and Aish Bagh are being thoroughly overhauled and one of those at the filtered station has commenced working. Owing to floods in September the filters were badly clogged but were got right by the superintendent in charge and the supply was not interfered with.

Wilkins filter module regulators are being fixed to the filter and two have already been fixed.

The quality of the filtered water supply throughout has been very good.

In order to increase the supply of water at Lucknow four tube wells were put down in the compound of the filtered water station at Aish Bagh. These tube wells are not working yet, but three wells are ready for pumping. The fourth is having the strainers lowered and pumping machinery is being arranged for.

Lucknow drainage works.—Surface drains as well as sewers in third and fourth sections of Sanitary Road have been completed and progress has been made on the construction of the intercepting sewer, rising main and distribution carriers in connection with the new sewage farm scheme now in hand.

A project for a sewage scheme for the public offices and United Service Club at Lucknow has been sanctioned by Government. This work will be started when the Ghasiari Mandi intercepting sewer is completed.

Meerut water works.—The water works station at Bhola has been well looked after and the quality of water supplied was excellent throughout the year. To prevent the wastage of water one sub-inspector has been appointed. The filters require complete renewal. Funds are available and the work will be taken in hand soon.

Mussoorie water works.—The pumps at both stations worked very well throughout the year. The remodelling of no. 1 pump is completed and that of no. 2 nearly finished.

The work on the Landour Bazar drainage scheme was in abeyance during the year pending the preparation of a revised scheme for the outfall. This has now been completed and forwarded to the chairman of the municipal board.

Naini Tal water works.—The engines and boilers were kept in good working order, though the boilers are showing signs of wear. The filter plant was not used during the year as the quality of the water was excellent.

All the collecting reservoirs and standposts were cleaned out and high level springs were visited once a week and kept in a wholesome condition.

The new reservoirs were erected for the intermediate pipe line system and a new five-inch pipe to the pilgrims' spring was put in.

reservoirs of
intermediate
pipe line.

Naini Tal drainage.—The main sewer was found to be badly incrusted and proposals for scraping it are before the board. This work is very urgent and must be completed this cold weather.

Jhansi water works.—Two pumps and two boilers were purchased to replace those previously supplied and condemned by the municipality. These require to be erected. A comprehensive water supply scheme is being prepared for this place and will be finished shortly.

Mirzapur water works.—During the year the water works were maintained by the Public Works department as a contribution work at a cost of Rs. 7,224 and certain improvements were carried out at a cost of Rs. 4,290. It is proposed to buy some more meters to avoid the difficulties met with in realizing revenue on water sold and to check the consumption of water.

Boring division.—Mr. Beveridge, Executive Engineer, held charge of the Well Boring Operations division throughout the year.

The following were the more important works carried out by him :—

(1) Construction of the Fyzabad pumping station, including the wells, tunnels, engine house and staff quarters.

(2) Construction of part of the Muttra water works pumping station, including wells, central sump, suction tunnels and pipes.

(3) Construction of three percolation wells at Hardwar now handed over to the municipality.

(4) Construction of the Aligarh pumping station, including wells, tunnels, suction pipes and staff quarters.

The tube wells sunk during the year include 3 at Aligarh, 2 at Allahabad, 3 at Lucknow and 1 at Benares. The total number being 18, of which 17 were entirely successful.

The workshop equipped for the Boring division has proved most useful and has effected a considerable saving not only in repair charges but in the time required to carry them out.

As regards construction of new water supply schemes the water works scheme at Muttra is practically completed except for the pumping plant which has not yet arrived. At Fyzabad the pumping station is nearly ready and the pumping machinery will arrive shortly, but nothing has been done as regards the distribution mains and the municipality do not seem to be in any hurry to push on with their scheme. At Aligarh the pumping station and wells will shortly be ready, and it is hoped the municipal board will see their way to push on with the remainder of their scheme. Owing to the war great difficulty has been experienced in getting supplies of materials and machinery and the completion of schemes in hand is being rendered very difficult in consequence, but on the whole the progress for the year has been very satisfactory.

A sum of Rs. 17,07,909 was spent on original sanitary works during the year under Sanitary Engineer's supervision and a sum of Rs. 6,28,140 was spent on the maintenance and repairs of open water works, also under Sanitary Engineer's supervision. The total expenditure for the year being Rs. 23,36,049 as shown in appendix VI of the report. The value of projects dealt with by the Sanitary branch during the year amounted to Rs. 1,21,35,942. Many of these are large projects now practically completed, but as these were not finally submitted for sanction before the 31st March they are not shown in this year's work. The value of projects actually submitted for sanction amounted to Rs. 46,03,283 of which projects to the value of Rs. 8,96,638 were finally sanctioned during the year, the remainder being still under consideration. These schemes are prepared by a temporary staff of trained assistant engineers and subordinates working under Mr. Hoey, Executive Engineer, and under Messrs. Knox and Platt, Assistant Sanitary Engineers. Mr. Hoey's division also carried out construction works to the value of Rs. 3,02,742 during the year. Mr. Beveridge, Executive Engineer, with a staff of temporary subordinates, dealt with all the estimates and the construction for tube well supplies. The expenditure for his division amounted to Rs. 2,59,799 for the year.

Mr. Morris, Assistant Sanitary Engineer, and Mr. Newson, Assistant Engineer, looked after the maintenance of open water works during the year. The results achieved were incommensurate with the labour involved and some more satisfactory method of dealing with the supervision and repairs to machinery of open water works will have to be devised. The matter is receiving consideration.

Mr. Morris has joined the Indian Army Reserve of Officers and Mr. Newson has resigned to take up munition work in England; so the supervision of the maintenance of open water works is now again directly under the Sanitary Engineer.

I wish to place on record my appreciation of the good work done by Mr. Beveridge and Mr. Hoey, Executive Engineers, and Mr. Platt and Mr. Knox, Assistant Sanitary Engineers, during the year. The staff of assistant engineers, subordinates and draftsmen with one or two exceptions have all done well. The clerical staff both in these branch offices and at the head office have also worked well. There has been a marked improvement in the quality and quantity of the work turned out by these offices during the year, and more especially is this the case in the I Sanitary circle under Mr. Hoey.

There is no doubt that the carrying out of the construction of sanitary works directly by the Sanitary Engineer's staff tends to greater efficiency; and it is hoped that wherever this is possible sanitary works will in future be constructed through the Sanitary Engineer's staff.

NAINI TAL:

The 1*st July*, 1916.

C. H. WEST,

Sanitary Engineer to Government,
United Provinces.

APPENDICES.

APPENDIX

Statement of operations

Particulars.	Agra.	Allahabad.	Benares	Cawnpore.
Population.				
By Census of 1911 in Municipality	163,935	159,701	199,868	173,973
Ditto Cantonments	21,514	11,996	3,936	21,517
Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868	173,973
Consumption of water.				
During the year including Cantonments, gallons	1,264,534,500	*1,167,926,263	1,568,220,845	1,815,393,874
Daily average including Cantonments ,,	3,427,689	3,148,361	4,284,756	4,960,084
Maximum daily average in any one month ,,	3,898,377	4,032,130	8,603,581	6,870,000
Water used for irrigation and manufacturing purposes, gallons	137,829,038	187,723,768	12,777,000	400,102,860
Water used for domestic purposes ,,	1,126,705,462	980,202,495	1,555,443,845	1,415,291,014
Water consumed per capita ,,	16·60	15·64	21·2	23·8
Daily average for Cantonments alone ,,	266,458	169,095	2,423	20,675
Number of house connections during 1915-16 ...	100	120	190	403
Number of metered connections	126	396	...	555
Annual receipts and charges.				
Maintenance charges ... ... Rs.	Rs. 84,246	Rs. 88,491	Rs. 94,135	Rs. 154,720
Cost per 1,000 gallons consumed	1·07 annas	1·21 annas	0·96 annas	1·31 annas.
Cost per 1,000 gallons per 100 feet lift ...	·557 ,,	·71 ,,	0·58 ,,	·933 ,,
Cost of water per 1,000 gallons including interest and sinking fund charges.	2·34 ,,	2·89 ,,	1·83 ,,	2·25 ,,
Lift of pump.				
From river to settling tanks	45 feet	94 feet	84·49 feet	81·8 feet.
From filtered water pumps to town distribution	147 ,,	76 ,,	79·63 ,,	58·5 ,,
Total, lift ...	192 ,,	170 ,,	164·12 ,,	140·3 ,,
Income from water works.				
Water rate recovered during the year Rs.	94,621	113,197	133,357	118,908
Sale of water and other receipts ,,	47,532	53,314	6,239	91,007
Total, income Rs.	142,153	166,511	139,596	209,915

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* Includes 15,625,900 gallons of unfiltered water for Khusru Bagh Gardens.

No. 1.

during the year 1915-16.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Mirzapur.	Dehra Dun.	Jhansi.
240,016	76,351	11,985	16,788	55,304	30,301	58,236
19,782	39,876	2,511	1,289	...		11,930
259,798	116,227	11,000	18,027	38.400	30,301	25,000
1,290,166,000	418,258,275	38,999,923	31,765,762	93,230,800	65,999,340	32,368,800
3,525,043	1,211,088	106,557	86,791	254,728	180,326	88,466
4,100,000	1,817,844	141,456	191,689	346,200	180,576	112,533
208,986,000	10,577,370	Nil	2,95,496	Separate figures not available.	...	1,397,441
1,081,180,000	432,680,905	38,999,923	31,470,266		65,999,340	30,971,359
11·3	10·17	9·63	4·77	6·64	5·95	3·2
261,000	448,372	426	3,535	Nil	...	594
330	121	249	238	125	Nil.	2
373	34	250	234	17	3	1
Rs. 93,924	Rs. 28,421	Rs. 20,699	Rs. 45,728	Rs. 7,224	Rs. 3,181	Rs. 7,371
1·89 annas.	1·05 annas.	8·6 annas	,, 1·44	1·36 annas	·72 annas	3·61 annas
·74 ,,	·76 ,,	·65 ,,	,, 0·19	Nil	...	2·5 ,,
2·326 ,,	2·58 ,,	Rs. 1·14	,, 2·16	...	...	5·12 ,,
122·8 ft.	15·16 ft.	Nil	Nil	Gravity ...	Nil	Two Pump
63·4 ,,	122·48 ,,	Main Pump 1,700 ft. Auxiliary Pump. 600 ft.	Ton-nochy 1,160 ft. Ayar-Patta 1,093 ft. Pil-grim. 240 ft.	Scheme ...	Nil	98·00 143·05
186·2 ,,	137·64 ,,	1,700 600	1,160 1,093 240	...	Nil	98·00 143·05
44,561	Nil.	21,870	29,200	...	...	1,865
1,24,807	43,886	4,649	12,367	2,077	2,399	407
1,69,368	43,886	26,519	41,567	2,077	2,399	2,272

APPENDIX No. II.

Annual maintenance accounts of water works in the United Provinces during the year 1915-16.

Names of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Mirza-pur.	Dehra-Dun.	Jhansi.
1. *Establishment.*—	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(a) Permanent establishment.	23,306	24,463	27,835	30,747	27,857	11,353	13,503	11,034	2,837	2,392	1,226
(b) Office contingencies.	1,578	874	1,187	976	496	5,611	465	145	75	80	38
(c) Rent ...	492	1,540	365	...	430	60	...	...	...	...	126
2. *Pumping.*—											
(a) Coal ...	26,808	23,355	33,025	63,321	40,880	500	...	26,335	...	...	3,991
(b) Oil and waste.	3,303	5,289	4,470	5,461	2,249	576	1,931	658	...	...	18
(c) Other stores.	3,473	3,232	4,479	1,498	3,000	2,894	2,890	339	...	...	24
3. *Intake.*—											
(a) Training river.	...	...	...	2,785	...	...	...	...	...	...	828
(b) Clearing channels and wells.	5,462	684	13	523	71	50	...	24	...	...	5
4. *Settling tanks and filters*—											
(a) Clearing settling tanks.	400	488	43	988	3,623	50	...	...	...	...	...
(b) Clearing and renewing filter beds.	6,046	2,425	1,500	24,161	497	3,511	...	...	...	...	...
(c) Purchase of sand.	7,898	948	5,430	7,399	4,836	...	...	...	...	...	...
(d) Purchase of alumina ferric.	...	...	...	...	...	...	...	...	...	...	...
5. *Distribution.*—											
(a) Pipes and fittings.	1,286	8,499	3,504	5,267	1,142	1,241	394	2,393	...	569	56
(b) Meters ...	311	1,498	...	3,098	3,339	...	77	1,514	...	50	2
6. *Repairs.*—											
(a) To tanks	271	150	117	...	94	...	139	85	966	...	2
(b) To buildings and grounds.	1,014	1,489	1,486	1,189	650	932	485	628	25	40	6
(c) To machinery.	2,598	12,986	10,416	6,886	4,547	1,483	723	1,717	2,546	...	4
(d) Rising mains.	...	...	249	...	...	...	...	...	...	...	...
Water analysis.	200	1,031	16	421	213	160	92	806	771	50	
Total, expenditure	84,246	88,491	94,135	154,720	93,924	28,421	20,699	45,728	7,224	3,181	7,37

* Cost of water.

APPENDIX No. III.

Statement showing initial capital cost of subsequent extensions and improvements incurred on water works in the United Provinces to the end of 31st *March,* 1916.

Water works stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extensions during the year 1915-16.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	814,521	1,67,150	21,52,432
Allahabad	16,24,061	538,758	61,502	22,24,321
Benares	25,61,881	668,119	45,773	32,75,773
Cawnpore	14,44,570	906,821	93,151	24,44,542
Lucknow	15,15,736	613,461	88,250	22,17,447
Meerut	7,51,710	44,205	Nil	7,95,915
Mussoorie	1,14,014	70,689	6,110	1,90,813
Naini Tal	2,47,000	353,009	22,325	6,22,334
Dehra Dun	97,241	79,514	Nil	1 76,755
Mirzapore	6,29,508	8,292	28,368	6,66,168
Jhansi	96,556	10,670	3,926	1,11,152

APPENDIX No. IV.

Statement showing rate of filtraion and results of water works of the United Provinces during the year 1915-1916.

Municipalities.	Rate of filtration gallons per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.	
	Maximum.	Minimum.	Average.	Good.	Bad.	Total,	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies
Agra	37	23	29·8	2	Nil	2	56	Nil
Allahabad	49·6	6·2	38·5	2	Nil	2	373	26
Benares	55·43	22·61	31·66	2	Nil	2	313	6
Cawnpore	50	5	41·7	...	...	...	338	5
Lucknow	50	6·25	28·5	2	Nil	2	380	18
Meerut	87	7·75	22·56	2	Nil	2	204	3
Mussoorie	...	...	...	...	...	...	...	...
Naini Tal	...	...	...	1	...	1	...	...

APPENDIX No. IVA.

Statement showing the use of filters at various water works during 1915-16.

Municipalities.	Rate of filtration in gallons per square foot per day.		Percentage of filter area always out of operation during the year.
	Average rate on total filtering area.	Average rate on area in operation (see appendix no. IV.)	
Agra	24·6 gallons per square foot.	29·8 gallons per square foot.	17·5 per cent.
Allahabad	26·2 ,,	38·5 ,,	32·0 ,,
Benares	26·7 ,,	31·66 ,,	15·7 ,,
Cawnpore	35·4 ,,	41·7 ,,	15·2 ,,
Lucknow	25·2 ,,	28·5 ,,	11·6 ,,
Meerut	20·1 ,,	22·56 ,,	11·0 ,,

APPENDIX

Details of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
1. Consumption of water per capita in gallons per diem.	16·60	15·6	21·2	23·8
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868	173,973
3. Water used for irrigating and manufacturing purposes.	137,829,038	187,723,768	12,777,000	400,102,860
4. Power of pumps per hour in gallons at river.	2. Horizontal pumps each—28 H. P. Designed for 84,000 Maximum ... 96,000 Average ... 78,000 1 Worthington low duty pump— Designed for 120,000 Maximum ... 132,000 Average ... 102,000 2 Diesel Engines 55 H. P. Designed for 180,000 Maximum... 228,000 Average ... 192,000	2 Beam Engines 102 H. P. Designed for 126,000 Maximum ... 154,961 Average ... 114,862 1 Triple Expansion Engine H. P. 120 Designed for 192,000 Maximum ... 192,000 Average 1,56,250	2 Horizontal Engines each 141 H. P. Designed for 252,000 Maximum ... 189,140 Average ... 172,383 1 Worthington high duty pumping engine 250 H. P. designed for gallons 500,000	Two Engines each—86 H. P. Designed for 187,500 gallons. Maximum 187,500 gallons. Average 154,467 gallons. One Engine—100 H. P. Designed for 217,500 Maximum 235,800 Average 208,580
5. Power of pumps per hour in gallons at filter.	2 Beam engines each 100 H. P.— Designed for 192,000 Maximum... 200,000 Average ... 180,000 1 High duty Worthington—130 H. P. Designed for 150,000 Maximum... 156,000 Average ... 144,000	2 Beam engines each 135 H. P. Designed for 223,300 Maximum ... 265,000 Average ... 188,453	4 Beam Engines of 144 H. P. Designed for 462,000 Maximum ... 455,809 Average ... 375,150	Two Engines each—80 H. P. Designed for 187,500 Maximum 187,500 Average 171,180 One Engine— Designed for 283,140 Maximum 338,238 Average 288,470
6. Number of rising mains ...	2	1	2	2
7. Length of rising mains ...	2·5 and 1·75 miles respectively.	1·9 miles	Old rising main 4,727′ New „ „ 4,100	1·32 miles
8. Size of rising mains ...	28″ and 18″	20″	Both 24″	Each 20″ dia.
9. Number of settling tanks ...	5	3	3	3
10. Size of settling tanks ...	Each 266′ × 151′	Each 280′ × 180′	(288′ + 20′) × (238′ + 20′) × 15′.	Each 355′ × 255′
11. Capacity of settling tanks in gallons.	2,200,000	1 and 3 = 4,400,620 2 = 4,455,626	1 and 3 = 6,436,120. No. 2 = 6,508,927 gallons.	Each 3,000,000.
12. Number of filters ...	7	6	8	7
13. Size of filters ...	Each 200′ × 100′	200′ × 100′	200′ × 100′ × 6′—4½″	200′ × 100′
14. Number of C. W. reservoirs ...	3	2	2	2

N[illegible] V.

Mains, etc., in the Water Works of the United Provinces for 1915-16.

Lucknow.	Meerut.	Mussoorie.	Naini Tal.	Mirzapur.	Dehra Dun.	Jhansi.
11·5	10·17	9·68	4·77	6·64	5·95	3·2
259,798	116,227	11,000	18 027	38,400	30,301	25,000
208,986,000	10,577,379	...	2,95,496	Not available.	Nil.	1,397,44
Engines of 130 H. P. esigned for 187,500 Iaximum 188,237 verage 178,517	One Engine of 130 H. P. Two Turbines 980 H. P. Designed for 72,000 Maximum ... 61,985 Average ... 37,037	... ... (a) Main pumps: Designed for 10,800 Average . 10,900 Maximum not known (b) Auxiliary pumps. Designed for 4,800 Average ... 5,000 Maximum not known	Engine H. P. ... Lake station .. Designed for 14,355	... ...	... ...	... ...
			Three Engines each 31 H. P. Capacity ... 13,326			
wo Engines of 110 H. P. esigned for 187,500. Iaximum not known. verage 178,000	Second lift pump driven by same power. Designed for 66,000. Maximum ... 50,611 Average ... 30,327	(a) Main pumps (motor driven) two designed for (150 H. P.) (b) Auxiliary pumps (motor driven) one designed for 23 H. P.	... ...	... ...	... ...	... ... Two duplicate steam direct acting pumps having a capacity of 5,500 gallons each.
1	1	2	4			5
3·5 miles	15″ main=38,292′ 13″ main=8,550′	Murray Springs 1·18 miles ... John Mackinson Springs ... 1,400′	Ayarpatta ·93 miles Tonnochy ·66 „ Pilgrim ·34 „ Lake ·19 „	... ...	8·5 6·3	9″=3·65 miles. 6″=0·70 „ 6″=1·6 „ 4″=3,040 feet. 3″=5,040 „
20″	13″ and 15″	Murray springs 5″ ... John Mackinson Springs ... 3½″	4″, 3½″, 3″, 4″.	...	3″	9″, 6″, 4″, 3″.
3	3	...	...	...	...	...
250′×200′	100′×60×11′	...	...	...	...	...
	5,28,000 gallons each.					
7	4	...	1 J. wel filter 12′ dia.	...	...	...
200′×100′	150′×100′	...	...	...	...	...
2	1	1	5	...	...	...

APPENDIX

Details of Pumps, Filters, Tanks, Reservoirs, Rising,

Particulars.	Agra.	Allahabad.	Benares.	Cawnpore.
15. Size of C. W. reservoirs ...	103′ ×105′ × 10′	Each 160′ × 103·3 ×12	(178′—4″) × (148′—4″) × (16′—1″	Each 135′ × 106—8″ × 12′ deep.
16. Capacity of C. W reservoir in gallons.	676,000	1,168,700	1,879,631	Each 953,300 gallons.
17. Number of service reservoirs or stand pipes.	3	1	1	2
18. Size of service reservoir ...	One 66′ dia. × 11″—4″ deep. Two 20′ dia. × 50′ deep.	60′ dia. × 11′ deep	60′ dia. × 15′ deep	Balancing tanks 2 50′—6″ high × 36′ dia. 50′—6″ high × 40 dia.
19. Capacity of service reservoir	438,000	194,000	260,000	Holds 318,087 gallons. 392,700 gallons.
20. Number of public stand-posts.	43 four-tap stand-posts each $\frac{3}{4}$″ size; 62 two-tap stand-posts of $\frac{3}{4}$″ size; 151 one-tap stand-posts.	One-tap stand-posts ... 144 Two-tap stand-posts ... 59 Four-tap stand-posts ... 80 Waste not cocks 13 Push cocks ... 13 Wall boxes ... 7 Bib cocks of $\frac{3}{4}$″ size ... 6	One-tap stand-post ... 244 Two-tap stand-posts ... 108 Four-tap stand-posts ... 80	97 four-tap stand-posts 52 two-tap stand-post. 90 one-tap stand-posts. 5 Bathing platforms.

No. V.

Mains, etc., in the Water Works of the United Provinces for 1915-16—(concluded).

Lucknow.	Meerut.	Mussoorie.	Naini Tal	Mirzapur.	Dehra Dun.	Jhansi.
Each 105'×107'.	48'×52½'	2×(40'×25×8'). 1×(30'×20'×8'). 1×(80×24×6).	... ...			
798,500 gallons each.	110,600	2 of 50,000 gallons each 1 of 3,000 gallons. 1 of 7,200 gallons.				
2*	2	20 Iron service tanks.	5	1	1	
66'×12'	2—Each 25'×34'.	1. 10×10×4 4. 8×8×4 10. 8×4×4 5. 4×4×4	28 Round service tanks 3'×3', 28 round service tanks 2'—8"×3', [18 squr. tanks 6'×8'×4'.	Area, 14,889 sq. ft. depth 14 ft. capacity 208,446.	1 Service reservoir holding 210,950 gallons.	40'×15'×8' to hold 30,000 gallons.
250,600 350,000	100,000 gallons each.	1 of 2,500 gallons. 4 of 1,600 10 of 800 gallons. 15 of 400 gallons.				
199 one-tap stand-posts 231 two-tap stand-posts.	38 one-tap stand-posts of ¾"; 93 two tap stand-posts of ¾"; 3 wall fountains 4 taps of ½".		64 service tanks. 27 stand-posts.	32 one-tap stand-post with 2½" hydrant. 1 one tap stand-post without hydrant. 25 two-taps standpost with 2½" hydrants. 1 two-taps standpost without hydrant. 7 Four taps standposts with 2½" hydrants. Hydrants 111 washouts 7.	Tank of G. I. sheets different sizes are holding 2,050 gallons.	1 Service tank with 50 taps. 7 Iron tanks with 6 taps
					14	
					Standposts with 2 brass cocks 1 standpost of 1 tap.	10 standposts with each two taps.

* One in cantonments.

APPENDIX No. VI.

Detailed statement of the expenditure incurred on works of a sanitary nature under the supervision of the Sanitary Engineer during 1915-16.

	Water works (original.)	Water works (maintenance.)	Drainage works.	Other works.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.
1. Agra	167,150	84,246	5,334	3,310	2,60,040
2. Allahabad ...	61,502	88,491	1,56,804	...	3,06,797
3. Benares	45,773	94,135	91,722	...	2,31,630
4. Cawnpore	93,151	154,720	75,864	...	3,23,735
5. Lucknow	88,250	93,924	14,906	3,475	2,00,555
6. Mussoorie	6,110	20,699	13,701	...	40,510
7. Meerut	...	28,421	14,093	...	42,514
8. Naini Tal	22,325	45,728	...	...	68,053
9. Mirzapore	28,368	7,224	...	...	35,592
10. Debra Dun ...	...	3,181	26,143	8,000	37,324
11. Jhansi	3,926	7,371	...	...	11,297
12. Khurja	942	...	...	...	942
13. Fyzabad	60,576	...	3,500	...	64,076
14. Hardwar	118,020	...	...	2,106	1,20,126
15. Bahraich	2,761	...	114,889	2,995	1,20,645
16. Aligarh	40,919	...	...	...	40,919
17. Tilhar	...	...	1,235	...	1,285
18. Baraut	...	...	633	...	633
19. Aonla	...	...	412	...	412
20. Kanauj	...	...	2,207	...	2,207
21. Muttra	2,37,967	...	82,279	...	3,20,246
22. Jaunpore	1,259	...	45,070	...	46,329
23. Shahganj	...	...	36,003	...	36,003
24. Deoband	...	...	1,512	...	1,512
25. Bindki	339	...	...	...	339
26. Hathras	408	...	...	...	408
27. Unao	3,188	...	...	...	3,188
28. Etawah	316	...	...	...	316
29. Hapur	45	...	...	...	45
30. Dhampur	...	...	18,421	...	18,421
Total ...	9,83,295	628,140	7,04,728	19,886	23,36,049

APPENDIX No. VII.

Comparative statement of working expenses of water works schemes in the United Privinces for 1915-16.

No.	Name of water works.	Class of work, gravitation or pumping.	Coal consumption per 1,000 feet gallons.	Price of coal per ton.	Total lift including friction.	Percentage of charges for—			Average consumption in gallons per head per day	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet gallons, for pumping scheme	Cost of maintenance per head of population.	Cost of pumping per 1,000 feet gallons.	Income per head of population	Remarks.
						Establishment.	Coal.	Other charges.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
				Rs. a. p.						As.	As.	As.	As.	As.	
1	Agra ...	Pumping...	0·09 lbs.	12 10 0	192 feet.	27·66	31·82	40·51	16·60	1·07	0·05	7·27	·002	12·26	
2	Allahabad ...	Ditto ...	·027	9 12 0	170 feet.	27·63	26·39	45·98	15·64	1·21	·71	8·25	·03	15·5	
3	Benares ...	Ditto ...	·03	9 14 0	164 feet.	29·56	35·08	35·34	21·2	0·96	·01	7·39	·0051	10·95	
4	Cawnpore ...	Ditto ...	...	10 9 6	140 feet.	20·5	40·93	38·57	23·8	1·31	·0097	14·23	·0044	19·295	
5	Lucknow ...	Ditto ...	·33	12 0 0	186 feet.	29·5	45·3	25·9	11·3	1·39	·012	5·7	·005	11·5	
6	Meerut ...	Ditto ...	Turbine worked by power*.	...	137 feet.	39·95	6·63	58·42	10·17	1·05	·0075	3·91	·0059	6·04	* The pumps are driven by electric motors. The current being generated by water power.
7	Mussoorie ...	Ditto ...	...	Nil	Main pumps 1,700 Aux. ,, 600	67·4	Nil	32·6	9·68	8·6	6·5	Rs. 1·88	5·9	Rs. 2·40	
8	Naini Tal ...	Pumping and gravitation supply.	·068	Coal at Rs. 30 per ton wood at Rs. 19 per 100 mds.	Tonnochy 1,160 Ayarpatta 1,093 Pilgrim 240	24·13	57·59	18·28	4·77	1·44	·0028	2·72	·00187	2·8	
9	Mirzapore ...	Gravitation.	...	..	...	35·6	Nil	64·41	6·64	1·36	Nil	As. 2·1	Nil	As. ·38	
10	Dehra Dun...	Ditto ...	...	...	...	75·18	...	24·82	5·95	·72	...	·10	...	·08	
11	Jhansi ...	Pumping...	·176	11 5 0	Two pumps 98 One pump 143	6·63	54.14	39·23	3·2	3·61	·0304	2·08	·0240	1·71	

APPENDIX VIII.

Projects submitted and sanctioned during the year 1915-16.

	Rs.
(1) Deoband diversion of Municipal drain	2,903
(2) Bindki paving and drainage new bazar	8,176
(3) Benares repairing old engines	15,426
(4) Bahraich outfall sewer	11,201
(5) Fatehgarh drainage	5,637
(6) U. S. Club and puplic offices at Lucknow	33,581
(7) Benares construction of a road between Ramanpura and Madanpura	1,44,472
(8) Hardwar Kumbh Mela water supply	1,62,617
(9) Pilibhit Civil Station	15,951
(10) Muttra revised water supply	4,83,724
Total	8,96,688

Projects submitted but not yet sanctioned.

(1) Badshahpur drainage	59,445
(2) Ram Nagar drainage	1,40,823
(3) Baraut drainage	36,113
(4) Bahraich flushing	35,567
(5) Aligarh water supply	6,38,656
(6) Muktesar sanitation	22,811
(7) Fyzabad water supply (revised)	6,89,180
(8) Do. flushing scheme	16,103
(9) Landaur Bazar Drainage scheme (revised)	2,96,036
(10) High Court drainage and water supply	59,750
(11) Khurja water supply and flushing scheme	1,46,250
(12) Agra water supply improvements	10,51,000
(13) Cawnpore Cantonment water supply	22,498
(14) Allahabad water supply (unfiltered)	2,32,030
(15) Sewering municipal office, Lucknow	33,000
(16) Lucknow sullage farm	1,57,000
(17) Special repairs, Allahabad engines	46,000
(18) Special repairs, Benares engines	30,000
Total	37,12,262

Project on which work is on hand.

(1) Agra drainage and sewerage	15,00,000
(2) Cawnpore drainage and sewerage	20,00,000
(3) Bareilly drainage and flushing scheme	8,00,000
(4) Cawnpore water supply extension	4,00,000
(5) Naini Tal hydro electric scheme	3,00,000
(6) Saharanpur water supply	5,00,000
(7) Do. drainage scheme	3,69,808
(8) Lucknow water supply extension	1,50,000
(9) Unao water supply	1,00,000
(10) Almora drainage and water supply	30,000
(11) Haldwani, water supply	50,000
(12) Kydganj drainage	1,35,251
(13) Hardwar (supplementary) water supply	70,000
(14) Jhansi water supply	6,00,000
(15) Nimsar improvement	60,000
(16) Gola Gokarannath improvement	40,000
(17) Machhlishahar drainage scheme	45,000
(18) Moradabad water supply and flushing scheme	1,50,000
(19) Brindaban water supply	2,00,000
(20) Dehra Dun flushing	25,000
(21) Hapur drainage improvement	2,500
Total	75,27,559

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Twentieth Annual Report

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES

For the year ending 31st March 1915.

ALLAHABAD:
PRINTED BY F. LUKER, SUPERINTENDENT, GOVERNMENT PRESS, UNITED PROVINCES.
1915.

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1915.

Twentieth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending 31st March 1915.

The post of Sanitary Engineer was held by Captain V. Giles, R.E., from 1st April 1914 to 22nd October 1914; Mr. Karm Chand, from 23rd October 1914 to 28th November 1914; and Mr. C. H. West, from 29th November 1914 to the close of the year.

Captain Giles, on being relieved, reverted to military employment and Mr. Karm Chand reverted to the Buildings and Roads branch of the Public Works department.

The following officers joined the Sanitary Engineer's establishment :—

Mr. G. Mc Hoey, from 1st April 1914.
Mr. A. S. Knox, from 29th March 1914.
Mr. S. E. Platt, from 2nd October 1914.
Mr. W. G. Morris, from 10th October 1914.

Mr. Hoey came from the Buildings and Roads branch of the Public Works department and the others were appointed by the Secretary of State for India.

With the reversion for Mr. Karm Chand to the Buildings and Roads branch the net increase in the staff has been three gazetted officers.

Besides the eight larger municipalities, 26 of the smaller municipalities, eight notified areas and six other towns were visited during the year in connection with Sanitary schemes. The following officers were employed on the construction of sanitary works under the Buildings and Roads branch of the Public Works department.

Mr. G. E. Rhodes, Assistant Engineer, was employed on the construction of a portion of the Allahabad drainage works (estimated cost Rs. 6,87,765). He belonged to the Royal Engineer reserve and had to leave on the outbreak of war, being relieved by Mr. C. F. Hunter, Assistant Engineer, who took charge of the drainage sub-division in addition to the district work.

Mr. H. J. Amoore, District Engineer, Muttra, took over charge of the Muttra drainage and water-works construction (estimated cost Rs. 3,97,254 and Rs. 2,99,368 respectively) in addition to his district work with Mr. Miles, Temporary Assistant Engineer, to help him.

Mr. H. Northcote, District Engineer, Bahraich, was placed in charge of a portion of the Bahraich drainage works (total estimated cost Rs. 3,72,678), in addition to the district work with Mr. Sheoraj Bahadur, temporary Assistant Engineer to help him. Mr. Northcote has now joined the Indian Army Reserve of Officers and Mr. Sheoraj Bahadur has taken over his work.

The District Surveyor of Jaunpur is in charge of the Shahganj drainage scheme (estimated cost Rs. 69,848), the expenditure up to date is Rs. 27,705 and the expenditure for the year Rs. 17,793.

The District Surveyor of Bijnor has charge of the Dhampur drainage, costing Rs. 82,811, about half the work including the construction of the two main drains is being taken up at present.

The District Engineer of Budaun has charge of a portion of the Budaun drainage scheme (estimated cost Rs. 3,10,876). Work to the value of Rs. 93,255 has been completed and the value of the work now being done amounts to Rs. 30,722.

The Rikhikesh drainage scheme (estimated cost Rs. 1,01,572) has been completed under the supervision of the District Engineer, Dehra Dun.

The District Engineer, Fyzabad, has had charge of the Fatehganj nala drainage scheme at Fyzabad (estimated cost Rs. 1,60,677). This work has been completed, only the flushing tanks remain to be put in.

There are a few smaller sanitary works also being carried out by the Buildings and Roads branch of the Public Works department. The more important are, drainage of civil station, Pilibhit, estimated cost Rs. 15,951. Khekra drainage—estimated cost Rs. 15,354. Garhmuktesar drainage—estimated cost Rs. 8,702.

The following members of the Sanitary Engineer's staff are working in the Buildings and Roads branch, on construction. Mr. Sheoraj Bahadur, temporary Assistant Engineer, Babu Puran Mal, overseer, Babu Ulfat Rai, Overseer and Khurshed Ali, Mukta Prasad and Ram Saran Das, Sub-Overseers.

In the larger municipalities, such as Agra, Allahabad, Benares, Cawnpore, Lucknow and Mussoorie, a good deal of work has been carried out by Municipal Engineers under the supervision of the Sanitary Engineer.

At Agra, Mr. Shute, the Municipal Engineer, had charge of the water works improvements (estimated cost Rs. 1,34,363). The five settling tanks have had their capacity nearly doubled by raising the sides and they have been converted into continuous flow tanks. The connections between the settling tanks and filters and between the filters and clear water reservoirs have been improved. Two new Deizel engines driving centrifugal pumps of a capacity of 3,000 gallons a minute have been installed for a supply of unfiltered water at a cost of Rs. 50,000 for both sets including erection. The results have been very satisfactory as the economy in fuel amounts to Rs. 12 per day, which more than justifies the expenditure incurred on them. A second 18″ rising main has also been put in between the river pumps and the settling tanks.

Further detailed proposals for improvements in the distribution system based on the recommendations of a special committee which sat in 1913-14, are now ready and work on these will be started shortly. The cost of these new proposals including a supply of water for irrigation purposes comes to nearly nine lakhs of rupees.

At Allahabad, Mr. Acton, Municipal Engineer, had charge of the improvements to the Allahabad water works (estimate costing Rs. 2,90,538). This work is practically complete. A new engine has been installed at the unfiltered station and a new engine house and well and suction tunnel have been constructed. A new rising main 20″ diameter and 10,000′ long has been laid to the settling tanks—the sides of the settling tanks have been raised and their capacity increased, and a new filter has been put in. The pump well and pumps for the old engines are being lowered with a view of reducing the suction lift. The new suction tunnel however was found to be damaged owing to settlement in the foundations, the repairs to this are being carried out by the Public Works department.

A project for a supply of irrigation water from the tube wells for Rs. 1,49,961 was finally sanctioned by Government but it is being revised with a view of including a supply of water for Katra, Colonelganj and Daraganj to supplement the municipal supply.

Benares.—The waste meter system (estimated cost Rs. 85,248) is nearly complete. Two bulk meters and some smaller meters remain to be fixed. The progress made by the contractors is unsatisfactory. Mr. Blakiston, the Palatine Company's agent, was appointed superintendent for waste from the date, the first meter was fixed, on a salary of Rs. 300 a month. This was somewhat premature, it would have been better to have appointed a whole-time superintendent when the work was nearing completion as originally intended. A set of rules defining the superintendent's duties is required.

Two new water tube boilers each with a capacity for steaming two of the existing engines have been fixed at the filtered station—the estimated cost is Rs. 47,551.

A somewhat serious accident occurred in August last year. The foundations of the new pumps erected in 1910 were found to have settled and a large T piece on the delivery was cracked. This involved the dismantling of the pumps and putting in new foundations. As the suction lift was also excessive, it was decided to lower the pumps and pump well about 7′ at the same time. This work is now nearing completion, but for some months we have had to use the old pumps and engines with the result that Benares has been on a somewhat short supply of water during the summer months this year.

The total expenditure on original works and water works has been Rs. 1,45,396 during the year. Mr. Bailey, the Municipal Engineer, was engaged on completing a number of drainage works which were in hand the previous year. These were the intercepting ghat sewer—cost Rs. 68,650; the Masanghat improvement scheme—cost Rs. 68,650, and the drainage of the pacca mahals—cost Rs. 1,50,000. The first three works are complete and the last 2/3rds complete. Mr. Bailey was also employed on the lowering of the pump well of the new engine referred to above and has done the work very well. The expenditure on the drainage works above referred to was Rs. 50,957 for the year.

Mr. Alexander, Municipal Engineer, was in charge of the water works and drainage works at Cawnpore. The difficulty about obtaining water from the Ganges continued this year; the dry-weather channel being separated from the unfiltered water station by a stretch of two miles of dry sand. During the winter, a supply of water was obtained from the canal distributary but last summer a cut was made to the Ganges river chiefly with a view of testing the efficiency of the Puech-Chabal system of filtration, the results of these tests form the subject of a separate report. The cut was made at a cost of Rs. 50,276 against an estimate of Rs. 78,000. The water works extensions which included the erection of the filtration plant are now complete. The Halsey road water tower has been connected to the mains. There has been a marked improvement in pressure and Cawnpore has now a continuous supply.

As regards the drainage works, the drainage of the A. B. road is practically completed and two new water-flushed latrines near Sarsyaghat have been completed and brought into use.

The tube well at Benajhaber, after giving a little trouble at the start, is now working satisfactorily and giving very nearly ½ a million gallons per day and a second tube well is being sunk. As soon as the results from the second well are known a decision will be come to as regards the best method of securing a permanent supply of unfiltered water for Cawnpore during the dry months of the year.

At Lucknow, the following Sanitary works were carried out through the agency of Messrs. Lane Brown and Hewlett. Raising the settling tank at Aishbagh water works (estimated cost Rs. 11,696). Extension of Hasanganj pipe lines (estimated cost Rs. 46,476). Construction of a beef market (estimated cost Rs. 12,482). Drainage of model house areas (estimated cost Rs. 20,000). Sewer connection Oudh and Rohilkhand Railway (estimated cost Rs. 11,585). Branch Sewer Hazratganj, Oudh and Rohilkhand Railway (estimated cost Rs. 1,629). New Water Works plant Aishbagh—Pumping station (estimated cost Rs. 1,00,000). The expenditure on the last item was Rs. 30,712 only, this was due to the late arrival of the machinery owing to the war.

A sum of one and a half lakhs allotted by the Government of India for an experimental sullage farm at Jagauli across the Gumti was not spent owing to some delay in getting the project sanctioned. All details have now been settled and it is expected that the work will be put in hand shortly.

Improvements to the Mussoorie water supply pumping plant (estimated cost Rs. 61,700) are now nearly completed. The work is being carried out under Mr. Bell, Electrical Engineer, Mussoorie. Expenditure during the year was Rs. 43,388.

The expenditure on the Landour Bazar improvement scheme was Rs 80,135 during the year making a total expenditure of Rs. 2,04,520 up to date. Most of the work is completed. The north road is finished but the water-flushed latrines remain to be installed. A portion of the south road near the Castle Hill gate is also incomplete and the question of its alignment is being settled with the Survey authorities. The suggestion of having a sullage farm at Arnigadh has been abandoned. The whole of this sullage will now be taken down the Butcher khana ravine. This involves pumping but the power required is very small and two small electrically driven centrifugal pumps will be put in for the work. This work was under Mr. Clifford (retired Public Works department) but is at present under Captain Anderson, Municipal Engineer, Mussoorie. An estimate for the revised proposals is being submitted for sanction.

A scheme for the water supply of the Hardwar-Union has been under preparation for some time and early this year on the near approach of the Kumbh Mela with cholera fairly widespread in these provinces, a suggestion was made by the Sanitary Commissioner that the portion of the water supply scheme relating to Hardwar town should be pushed through so as to secure an ample supply of drinking water for the large number of pilgrims who were expected at Hardwar. There were practically two months left in which to complete the work and 650 tons of pipes had to be laid—but Mr. Hoey, Executive Engineer and Mr. Platt, Assistant Engineer, with Mr. Cameron, Clerk of works, undertook to get the pipes laid and the pilgrim water tanks erected, and Mr. Beveridge, Executive Engineer, took over the construction of percolation wells and the arrangements for pumping. By dint of hard work on the part of the staff mentioned above a plentiful supply of good drinking water was secured in time for the Mela. There was no hesitation on the part of the pilgrims in taking the piped supply and they all seemed very grateful for the arrangements made for their comfort.

Boring division.—Mr. Beveridge, Executive Engineer, held charge of the special Boring division. A considerable measure of success has been achieved with the tube well experiments in these provinces. This result is largely due to Mr. Beveridge's zeal and energy in carrying out this work with the very slender staff at his disposal. The first tube well experiments were started as trial bores 6″ pipes reducing gradually to 3″ to ascertain if suitable water-bearing strata were available. The bores were so uniformally successful in allocating the water-bearing sand required everywhere that it was decided that we should give up sinking small trial bores which were troublesome to get down very deep and sink only full size 15″ bores in future as the extra cost was not great. This practice is now being followed.

The following 6″ trial bores were sunk during the year :—

	Depth.	Cost. Rs.	
(1) Hapur	238 ft.	1,512	Good and plentiful water obtained.
(2) Khurja	192 ,,	1,510	Ditto ditto.
(3) Allahabad (Thornhill Road)	310 ,,	2,787	Ditto ditto.
(4) Unao	217 ,,	1,609	Ditto ditto.
(5) Lucknow (Aishbagh) ...	253 ,,	2,815	Ditto ditto.
(6) Jaunpur	196 ,,	1,226	Water brackish.

Two other 6″ trial bores were also in hand at the close of the year at Hathras 317′ deep, and at Etawah 275′ deep. These have since been completed and have been successful.

Large 15″ tubes were put down at the following places some of which are still in hand :—

One at Benares, two at Cawnpore, four at Fyzabad, two at Allahabad, one at Unao, one at Lucknow, one at Aligarh, and three at Hardwar.

In addition to these a 7″ pipe was put down at Muttra by contract.

Tests have been carried out on two wells at Fyzabad. One with a 10′ Ashford strainer and 12′ depression head yielded 25,500 gallons per hour and the 2nd well with a 9″ Brownlie tube and 11½′ depression head yielded 33,660 gallons per hour.

No. 1 well at Cawnpore which did not work well to start with is now yielding nearly 500,000 gallons in 24 hours.

The well at Muttra gave a similar yield. The well used at Hardwar for the Mela supply yielded 25,000 gallons per hour but this is a percolation well in boulder soil and not a tube well.

The tube well at Aligarh yielded 27,000 gallons per hour with a 10′ depression head. The remaining wells have still to be tested, but there is no reason to anticipate that they will not give equally good results.

The importance of these tube wells to large water works stations for supplementing their filtered supply is very great. Tube wells are being sunk at Allahabad, Cawnpore, Lucknow and Benares and funds have been granted for similar wells at Meerut and Agra.

Besides well sinking and preparing estimates for wells, Mr. Beveridge has been employed on construction of the Fyzabad pumping station and in the preparing of estimates for the Cawnpore Town Extension Committee.

I consider these tube well experiments, the most important work now being done in these provinces, both from a sanitary and engineering point of view.

Open water works.—The quality of water supplied through the water works of these provinces was excellent throughout the year except at Allahabad which was not as good as usual. This was undoubtedly due in a great measure to the irregular way in which filters appear to have been worked by the superintendent in charge. The two last tests showed some filters at work at excessive filtration rates and excessive filtration heads while others were working at very low rates. The superintendent has been asked to pay closer attention to the working of his filters in future. There were no interruptions in the supply and no serious accidents except one at Benares, already described, and one at Allahabad where the gear wheels of the new engine stripped owing to the oil bath in which they work, being left with no oil in it, owing to the carelessness on the part of the staff.

The brass working parts of the venturi meter recorder at Allahabad also disappeared and were not traced and are said to have been stolen

The total expenditure on the maintenance of the eight large water works was Rs. 6,82,454 Mr. Morris, Assistant Sanitary Engineer, was employed in enquiring into the question of expenditure on open water works with reference to the cost and adequacy of the staff, the efficiency of the distribution and measures taken to prevent waste.

Mr. Newson, Assistant Engineer, was employed in carrying out engine and boiler tests with a view of standardizing expenditure and effecting economies in supplies. All minor defects found in carrying out these tests have been remedied and further recommendations for improving the efficiency and economy in working will be made when all the tests are complete. The enquiries into the working of the open water works have only been started this year as up to the present, no staff has been available for this purpose.

Most of the staff employed under Sanitary Engineer are engaged on project work. Last year, an experiment was made by dividing up the whole project staff into three circle offices with headquarters at Saharanpur, Lucknow and Cawnpore, while the Sanitary Engineer's headquarters was at Allahabad and the Boring Division headquarters at Cawnpore. The result has been that the volume of correspondence has been more than doubled but the results hoped for in increased efficiency are not quite apparent. The arrangments are being reconsidered.

The projects sanctioned, submitted for sanction and under preparation, are detailed in appendix viii. The work done in the preparation of projects has entailed a good deal of hard work on the part of Mr. Hoey, Mr. Platt, and Mr. Knox and the staff of the Assistant Engineers and subordinates working under them and I wish to record my appreciation of the good work done by them.

The clerical staff has worked well but they have been obliged to work for long office hours and on holidays to keep pace with the extra work due to increased correspondence.

This year a certain amount of construction work has been taken up by the Sanitary Engineer's staff. This is a move in the right direction as it gives the men a greater interest in their work and enlarges their experience. It is hoped that in time all the more important Sanitary Works will be carried out through the Sanitary Engineer's staff and it should be gradually strengthened for the purpose.

The value of 18 projects finally sanctioned in 1914-15 amounted to 18 lakhs. The value of 11 projects submitted for sanction amounted to 34½ lakhs, and the value of the projects actually taken up and under preparation comes to nearly 98 lakhs. Besides this, there are nearly 50 projects called for on the list on which work has not yet been started for want of establishment. The value of work executed under the Sanitary Engineer's supervision amounted to Rs. 19,67,000 (see appendix VI) exclusive of expenditure incurred on drainage and sewerage of new sanitary roads at Lucknow and Cawnpore, which form part of the Town Improvement Schemes.

C. H. WEST,
Superintending Engineer,
Sanitary Engineer to Government,
United Provinces.

ALLAHABAD :
The 25th June 1915.

APPENDICES.

APPENDIX

Statement of operations

Particulars.	Agra.	Allahabad.	Benares.
Population.			
By Census of 1911 in Municipality	163,935	159,701	199,868
Ditto Cantonments ...	21,514	11,996	3,936
Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868
Consumption of water.			
During the year including Cantonments, gallons	1,173,780,300	1,073,266,524	1,572,332,022
Daily average including Cantonments ,,	3,215,836	2,940,456	4,301,254
Maximum daily average in any one month ,,	3,756,838	3,674,261	6,088,368
Water used for irrigation and manufacturing purposes, gallons	131,029,167	128,258,050	13,971,000
Water used for domestic purposes ,,	1,042,751,133	945,008,474	1,558,361,022
Water consumed per capita ,,	15·40	14·22	21·36
Daily average for Cantonments alone ,,	240,960	149,090	3,609
Number of house connections during 1914-15	109	194	347
Number of metered connections	129	359	2 (34 district meters fixed during the year.)
Annual receipts and charges.			
Maintenance charges ... ... Rs.	Rs. 93,083	Rs. 1,00,675	Rs. 96,460
Cost per 1,000 gallons consumed	1·27 annas	1·49 annas	0·98 annas
Cost per 1,000 gallons per 100 feet lift ...	·661 ,,	·87 ,,	0·68 ,,
Cost of water per 1,000 gallons including interest and sinking fund charges.	2·64 ,,	3·28 ,,	1·94 ,,
Lift of pump.			
From river to settling tanks	45 ft.	94 ft.	78 ft.
From filtered water pumps to town distribution	147 ,,	76 ,,	65 ,,
Total, lift ...	192 ft.	170 ft.	143 ft.
Income from water works.			
Water rate recovered during the year Rs.	66,140	1,08,853	1,27,681
Sale of water and other receipts ,,	42,541	53,891	6,378
Total, income Rs.	1,08,681	1,62,744	1,34,059

No. I.

during the year 1914-15.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
173,973	240,016	76,351	11,985	16,788
21,517	19,782	39,876	2,511	1,239
173,973	259,798	116,227	11,000	18,027
1,766,864,131	1,229,760,000	403,379,905	38,700,356	24,517,548
4,840,723	3,369,205	1,105,150	106,028	67,171
5,307,627	4,200,000	1,865,074	149,995	151,398
404,555,824	191,667,000	10,144,910	Nil	358,945
1,362,308,307	1,038,093,000	393,234,995	38,700,356	24,158,603
21·4	10·94	9·27	9·64	4·53
...	273,000	399,064	1,149	4,136
268	Nil	83	198	224
618	34	35	199	220
Rs. 2,02,817	Rs. 93,539	Rs. 25,957	Rs. 21,099	Rs. 42,193
1·84 annas	1·21 annas	1·03 annas	8·7 annas	Re. 1·72
1·22 ,,	·61 ,,	·77 ,,	·51 ,,	Re. 0·22
2·7 ,,	2·4 ,,	2·84 ,,	Rs. 1·12	Rs. 2·66
86 ft.	127 ft.	15 ft.		Nil
64 ,,	70 ,,	117 ,,	Main Pump. 1,700 ft. Auxiliary Pump. 600 ft.	Tonnochy. 1,160 ft. Ayarpatta. 1,093 ft. Pilgrim, 240 ft.
150 ft.	197 ft.	132 ft.	1,700 ft. 600 ft.	1,160 ft. 1,093 ft. 240 ft.
Nil	39,442	Nil	Nil	27,584
1,04,016	1,14,385	45,512	10,031	10,301
1,04,016	1,53,827	45,512	10,031	37,945

APPENDIX No. II.

Annual maintenance accounts of water works in the United Provinces during the year 1914-15.

Name of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal
1. *Establishment.*—	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
(*a*) Permanent establishment.	24,268	25,423	29,490	31,132	27,639	11,271	¶12,438	11,360
(*b*) Office contingencies	1,535	408	1,019	1,933	426	5,090	451	140
(*c*) Rent	496	1,526	270	...	430	60	...	500
2. *Pumping.*—								
(*a*) Coal	35,340	37,971	32,997	63,834	44,186	§500	‖...	16,154
(*b*) Oil and waste ...	3,462	3,368	4,221	7,657	1,949	569	1,715	583
(*c*) Other stores ...	3,115	4,019	4,498	6,724	2,468	2,879	2,476	734
3. *Intake.*—								
(*a*) Training River ...	...	...	3	50,960	...	...	...	...
(*b*) Clearing channels and wells.	5,330	500	24	695	73	50	...	...
4. *Settling tanks and filters*—								
(*a*) Clearing settling tanks.	...	287	1,496	141	2,607	50	...	...
(*b*) Clearing and renewing filter beds.	4,483	2,365	1,785	14,617	34	3,207	...	...
(*c*) Purchase of sand ...	7,948	7,099	3,214	12,500	3,054	...	...	...
(*d*) „ of alumino ferric.	...	...	1,357	...	...	...	...	*198
5. *Distribution.*—								
(*a*) Pipes and fittings ...	1,135	8,061	4,017	1,694	1,400	840	431	3,916
(*b*) Meters ...	...	1,642	...	504	3,150	...	1,030	2,375
6. *Repairs.*—								
(*a*) To tanks ...	264	214	300	...	329	...	165	1,357
(*b*) To buildings and grounds.	767	1,234	1,261	999	468	972	898	708
(*c*) To machinery ...	4,897	5,608	10,407	9,058	5,104	469	1,422	3,117
(*d*) Rising mains ...	...	...	95	...	...	...	...	†3
Water analysis ...	43	950	6	369	222	...	64	1,048
Total, expenditure ...	93,083	1,00,675	96,460	2,02,817	93,539	25,957	21,099	42,193

* Filter house.
† Tools and plant.
§ Hydraulic power.
‖ Hydro-electric power.
¶ Includes staff on electric plant.

APPENDIX No. III.

Statement showing initial capital cost of subsequent extensions and improvements incurred on water works in the United Provinces to end of 31st March 1915.

Water works stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extensions during the year 1914-15.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	7,31,206	83,315	19,85,282
Allahabad	16,24,067	4,63,105	75,653	21,62,819
Benares	25,61,881	5,22,723	1,45,396	32,30,000
Cawnpore	14,44,570	8,84,589	22,232	23,51,391
Lucknow	15,15,736	5,00,709	1,12,752	21,29,197
Meerut	7,51,710	41,660	2,545	7,95,915
Mussoorie	1,14,014	27,301	43,388	1,84,703
Naini Tal	2,47,000	3,42,778	10,231	6,00,009

APPENDIX No. IV.

Statement showing rate of filtration and results of water works of the United Provinces during the year 1914-15.

Municipalities.	Rate of filtration gallons per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.	
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.
Agra	34	18	27	1	1	2	62	1
Allahabad ...	93	6	40	1	...	1	311	49
Benares ...	49	18	31	2	...	2	345	4
Cawnpore ...	50	19	42	...	...	...	172	2
Lucknow ...	50	3	28	1	...	1	256	6
Meerut ...	36	14	25	10	1	11	188	1
Mussoorie ...	...	...	...	...	...	...	...	...
Naini Tal ...	...	...	...	1	...	1	...	...

APPENI

Details of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.
1. Consumption of water per capita in gallons per diem.	15·40	14·22	21·36
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868
3. Water used for irrigating and manufacturing purposes.	131,029,167	128,258,050	13,971,000
4. Power of pumps per hour in gallons at river.	2 Horizontal pumps each—28 H. P. Designed for 84,000 Maximum ... 96,000 Average ... 78,000 1 Worthington low duty pump— Designed for 120,000 Maximum ... 132,000 Average ... 102,000 2 Diesel Engines 55 H. P.— Designed for 180,000 Maximum ... 228,000 Average ... 192,000	2 Beam Engines, 102 H. P. Designed for 126,000 Maximum ... 154,961 Average ... 114,862 1 Triple Expansion Engine—H. P. Designed for Maximum ... Average ...	2 Horizontal engines each 141 H. P. Designed for 252,000 Maximum ... 189,140 Average ... 172,383 1 Worthington high duty pumping engine 250 H. P. designed for gallons 500,000
5. Power of pumps per hour in gallons at filter.	2 Beam engines each 100 H. P.— Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1 High duty Worthington—130 H. P. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	2 Beam engines each 135 H. P. Designed for 223,300 Maximum ... 265,000 Average ... 188,453	4 Beam engines of 144 H. P. Designed for 462,000 Maximum ... 455,809 Average ... 375,150
6. Number of rising mains ...	2	1	2
7. Length of rising mains ...	2·5 and 1·75 miles respectively,	1·9 miles	Old Rising main 4,727′ New „ „ 4,100′
8. Size of rising mains ...	28″ and 18″	20″	Both 24
9. Number of settling tanks ...	5	3	3
10. Size of settling tanks ...	Each 266′ × 151′	Each 280′ × 180′	(288′ + 20′)×(238′+20′)×15′.
11. Capacity of settling tanks in gallons.	2,200,000	1 and 3=4,400,620 2=4,455,626	1 and 3=6,436,120. No, 2=6,508,927 gallons.
12. Number of filters... ...	7	6	8
13. Size of filters	Each 200′ × 100′	200′ × 100′	200′ × 100′ × 6′—4½″
14. Number of C. W. reservoirs ...	3	2	2

No. V.

Mains, &c., in the Water Works of the United Provinces for 1914-15.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
21·4	10·94	9·27	9·64	4·53
173,973	259,798	116,227	11,000	18,027
404,555,824	191,667,000	101,494,910	...	358,945
Two Engines each—86 H. P. Designed for 187,500 gallons Maximum 187,500 gallons. Average 154,467 gallons. One Engine—100 H. P. Designed for 217,500 Maximum 235,800 Average 208,580	Two Engines of 130 H. P. Designed for 187,500 Maximum 188,237 Average 178,517	One Engine of 26 H. P. Two Turbines 90 H. P. Designed for 72,000 Maximum 61,985 Average ... 37,037	Two motor driven pumps each 150 H. P. Designed for 2,500 Average ... 2,400 Maximum Not known	Engine H. P. Lake station Designed for 14,355
				Three Engines each 31 H. P. Capacity ... 13,326
Two Engine each—80 H. P. Designed for 187,500 Maximum 187,500 Average 171,180 One Engine— Designed for 283,140 Maximum 338,238 Average 288,470	Two Engines of 110 H. P. Designed for 187,500 Maximum Not known Average 117,028	Second lift pump driven by same power. Designed for 66,000 Maximum ... 50,611 Average ... 30,327	And 2 auxiliary pumps driven by motor with oil engines as stand-bye.	... ...
2	1	1	1	4
1·32 miles	3·5 miles	15″ main=38,292′ 13″ main=8,550′	1·18 miles	Ayarpatta ·93 mile. Tonnochy ·66 „ Pilgrim ·34 „ Lake ·19 „
Each 20″ dia.	20″	13″ and 15″	3½″	4″, 3½″, 3″, 4″.
3	3	3	...	...
Each 355′ × 255′	250′ × 200′	100′ × 60′ × 11′	...	...
Each 3,000,000.				
7	7	4	...	1 Jewel filter 12′ dia.
200′ × 100′	200′ × 100′	150′ × 100′	...	...
2	2	1	1	5

APPENDIX

Details of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.
15. Size of C. W. reservoirs ...	103′ × 105′ × 10′	Each 160′ × 103·3′ × 12	(178′—4″) × (148′—4″) × (16′—1″)
16. Capacity of C. W. reservoir in gallons.	...	1,168,700	1,879,631
17. Number of service reservoirs or stand pipes.	2	1	1
18. Size of service reservoir ...	66′ dia. × 11′—4″ deep	60′ dia. × 11′ deep	60′ dia. × 15′ deep
19. Capacity of service reservoir...	...	...	260,000
20. Number of public standposts	43 four-tap standposts each ¾″ size ; 62 two-tap standposts of ¾″ size ; 151 one-tap standposts.	One-tap standpost 144 Two-tap standposts 57 Four-tap standposts 80 Waste not cocks ... 13 Push cocks ... 12 Wall boxes ... 7 Bib cocks of ¾″ size 6	One-tap standpost 244 Two-tap standposts 108 Four-tap standposts 80

No. V.

Mains, &c., in the Water Works of the United Provinces for 1914-15—(concluded).

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
Each 135'×106'—8" ×12' deep.	Each 105'×107'	48'×52½'	80'×24'×6'	...
953,300	...	...	...	...
2	2*	2	3	5
Balancing tanks 2 50'—6" high×36' dia. 50'—6" high×40' dia. Holds 320,000 gallons	66'×12' ...	2—Each 25'×34'	... ...	28 Round service tanks 3'×3', 28 round service tanks 2'—8" ×3', 8 square tanks 6'×8'×4'.
97 four-tap standposts 52 two-tap standposts 87 one-tap standposts Bathing platforms 5	197 one-tap standposts 231 two-tap standposts, ...	38 one-tap standposts of ¾"; 93 two tap standposts of ¾"; 3 wall fountains 4 taps of ½". ...	12 iron tanks 32 standpipes of 2 taps.	64 service tanks, 27 standposts.

* One in cantonments.

APPENDIX No. VI.

Detailed statement of the expenditure incurred on works of a sanitary nature under the supervision of the Sanitary Engineer during 1914-15.

	Water Works (original).	Water Works (maintenance).	Drainage Works.	Other Works.	Total.
	Rs.	Rs.	Rs.	Rs.	Rs.
1. Agra	83,313	93,083	296	323	1,77,015
2. Allahabad ...	1,30,355	1,00,675	2,56,181	...	4,87,211
3. Benares... ...	1,45,396	96,460	50,297	...	2,92,153
4. Lucknow ...	80,845	95,539	27,875	15,087	2,19,346
5. Cawnpore ...	35,825	205,448		15,100	2,57,373
6. Mirzapur ...	6,277	...	...	120	6,397
7. Naini Tal ...	...	42,193	...	...	42,153
8. Meerut	...	25,957	...	...	25,957
9. Mussoorie ...	46,388	21,099	80,135	...	1,44,622
10. Hapur	1,510	...	...	...	1,510
11. Garmukhtesar ...	...	...	3,910	...	3,910
12. Shahganj ...	...	...	17,793	...	17,793
13. Bahraich ...	...	...	98,935	...	98,935
14. Budaun... ...	...	...	17,784	...	17,784
15. Muttra... ...	7,393	...	8,497	...	15,890
16. Boring division, Tools and Plant.	55,232	...	...	...	55,232
17. Boring division, Wells.	15,543	...	...	...	15,543
18. Hardwar ...	30,000	...	...	...	30,000
19. Aligarh... ...	6,891	...	...	...	6,891
20. Unao	4,487	...	...	...	4,487
21. Dhampur ...	...	...	...	12,036	12,036
22. Fyzabad ...	24,082	...	9,677	...	33,759
Total ...	6,70,537	6,80,454	5,71,380	42,666	19,65,037

This total excludes expenditure on sewerage and drainage works on new Sanitary roads at Cawnpore and Lucknow and town improvement schemes.

APPENDIX No. VII.

Comparative statement of working expenses of water works schemes in the United Provinces for 1914-15.

No.	Name of water works.	Class of work, gravitation or pumping.	Coal consumption per 1,000 feet gallons.	Price of coal per ton.	Total lift including friction.	Percentage of charges for—			Average consumption in gallons per head per day.	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet, gallons, for pumping scheme.	Cost of maintenance per head of population.	Cost of pumping per 1,000 feet gallons	Income per head of population.	Remarks.
						Establishment.	Coal.	Other charges.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
1	Agra ...	Pumping ...	0·20 lb.	Rs. a. p. 7 8 0	192′	26·07	37·96	35·96	15·40	As. 1·42	As. ·007	As. 8·03	As. ·003	As. 9·3	
2	Allahabad	Ditto ...	·016	10 4 0	170′	25·25	37·72	37·03	17·12	1·49	·0005	9·33	·0039	15·5	
3	Benares ...	Ditto ...	·03	10 14 0	143′	29·49	32·99	33·97	20·94	0·98	·01	7·57	·006	10·51	
4	Cawnpore	Ditto ...	·031	11 8 0	150′	16·30	31·47	52·22	27·8	1·84	·015	18·64	·006	9·56	
5	Lucknow ...	Ditto ...	·2	13 0 0	197′	29·5	47·3	23·9	12·9	1·21	·012	5·72	·006	9·47	
6	Meerut ...	Ditto ...	Turbine worked by power.*	Nil	132′	43·42	6·18	50·40	9·51	1·03	·007	3·57	·006	6·27	* The pumps are driven by electric motors. The current being generated by water power.
7	Mussoorie ...	Ditto ...	...	Nil	1,735′	58·9	...	41·1	9·64	8·7	5·12	Rs. 1·92	4·15	14·6	
8	Naini Tal	Pumping and gravitation supply.	·069	Coal at Rs. 30 per ton wood at Rs. 19 per 100 mds.	Tonnochy 1,160′ Ayarpatta 1,093′ Pilgrim 240′	26·92	38·29	34·79	4·53	1·72	·055	2·34	·035	2·10	

APPENDIX VIII.

Projects sanctioned during the year 1914-15.

		Rs.
(1)	Dhampur drainage scheme	70,921
(2)	Enlarging Hassanganj main, Lucknow	44,103
(3)	Muttra water works	3,97,254
(4)	New Babcock and Wilcox boilers, Benares	47,551
(7)	Benares waste meter system	88,248
(8)	Extending ghat sewer, Benares	10,992
(9)	Ballia main drainage scheme	89,880
(10)	Ballia street drains	33,966
(11)	Dehra drainage and sullage farm	75,980
(12)	Mirzapur Lanka Hill reservoir	7,640
(13)	Garmukhtesar supplementary drains	1,875
(14)	Meerut anti-malarial scheme	1,08,000
(15)	Tube well, Unao	6,003
(16)	Tube well, Thornhill Road, Allahabad	9,568
(17)	Revised estimate main drains and pumping station, Allahabad	6,87,765
(18)	Miscellaneous estimates, boring division, tube wells, trial bores, tools and plants	1,31,261
	Total	18,01,007

Projects submitted for sanction.

		Rs.
(1)	Ahraura drainage scheme	54,036
(2)	Out-fall sewer, Cawnpore	87,759
(3)	Muktesar sanitation scheme	21,697
(4)	Lowering pumps, Benares	16,477
(5)	Pilibhit drainage, Civil Lines	15,951
(6)	Budaun drainage	30,722
(7)	Pandohi diversion, Saharanpur	3,29,600
(8)	Cawnpore town extension (preliminary estimate)	25,00,000
(9)	Kumbh Mela water supply	167,000
(10)	Sandhila drainage scheme	152,000
(11)	Lucknow sullage farm	149,000
	Total	34,54,242

Projects on which work is now in hand.

		Rs.
(1)	Cawnpore sewerage and drainage	20,00,000
(2)	Agra sewerage and drainage	15,00,000
(3)	Water supply, Saharanpur	6,00,000
(4)	Aligarh water supply	6,37,000
(5)	Water supply, Hardwar-Union	6,50,000
(6)	Revised drainage scheme, Saharanpur	6,00,000
(7)	Baraut storm drainage	30,000
(8)	Agra water works extension	8,90,000
(9)	Drainage scheme, Ramnagar	1,43,000
(10)	Badshahpur drainage	54,000
(11)	Drainage, Lucknow public offices	28,000
(12)	Supplementary tube well water supply, Allahabad	3,00,000
(13)	Naini Tal hydro-electric scheme	2,75,000
(14)	Bareilly drainage scheme	6,00,000
(15)	Moradabad flushing and water supply scheme	6,50,000
(16)	Unao water supply scheme	1,20,000
(17)	Jhansi water supply scheme	4,50,000
(18)	Kydganj, Allahabad block drainage	1,50,000
(19)	Nimsar water supply and drainage	1,00,000
	Total	97,77,000

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Received

NINETEENTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31st MARCH 1914.

ALLAHABAD:
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Nineteenth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending the 31st March 1914.

The post of Sanitary Engineer to Government was held by Mr. C. H. West throughout the year until the 6th February 1914, when he was relieved by Mr. W. P. Housden, Superintending Engineer.

Besides the eight water works stations, the following places were visited by the Sanitary Engineer during the year for the purpose of inspecting works or advising municipalities regarding sanitary schemes :—

Khurja, Hardwar, Debra Dun, Saharanpur, Bareilly, Muktesar, Naini (Allahabad), Muttra, Mirzapur, Almora, Sitapur and Aligarh.

He also attended the Engineering Conference at Simla and the Sanitary Conference at Lucknow.

The Assistant Sanitary Engineer also visited the following places during the year :—

Agra, Cawnpore, Lucknow, Unao, Bareilly, Saharanpur, Baraut, Naini Tal, Fyzabad, Ajodhya, Benares, Meerut, Fatehpur, Muzaffarnagar, Moradabad, Kaimganj, Farrukhabad and Sikandrabad.

The following Engineering Officers were employed on the construction of sanitary works under the Public Works department :—

Mr. H. J. Amoore, Assistant Engineer, on the Mirzapur water works which are now nearly completed.

Mr. G. E. Rhodes, Assistant Engineer, was employed on the Allahabad drainage works.

Mr. Muhammad Ishaq Khan, Assistant Engineer, acted for him during the period he was on leave.

Mr. A. E. J. Hubbard, Temporary Engineer, was employed on the preparation of the Saharanpur water works scheme up to July 1913 after which he left the department.

Mr. R. Miles was employed on the construction of the Hapur and Khurja drainage works of which the former was completed in the month of September 1913 and the latter was finished at the end of the year under report.

Babu Shivaraj Bahadur, Assistant Engineer, was employed on the construction of the Bahraich drainage works.

Besides the above, about half a dozen men with good Engineering and Upper subordinates' qualifications were employed for training in sanitary works. Some of them have proved useful and prepared the following schemes during the year :—

	Rs.
Fyzabad and Ajodhya water supply scheme	600,452
Dehra Dun drainage scheme	72,114
Dehra Dun sullage farm	3,866
Agra water works extensions	134,363
Muttra water works scheme	398,190
Ghaziabad drainage scheme	16,031
Ghaziabad flushing scheme	38,841
Ghaziabad flushing and water supply combined	38,841
Anupshahr drainage scheme	3,804
Lucknow sullage farm	171,298
Lucknow Hassanganj pipe distribution main	41,068
Khurja flushing scheme	36,732
Khurja water supply scheme	79,954
Meerut balancing tank	33,670
Benares new boilers	47,551
Benares waste meter scheme	88,248
Benares raising the banks of settling tanks	17,354
Sitapur drainage scheme	41,890
Rasra drainage scheme	14,105
Rasra tank filling scheme	8,506
Allahabad unfiltered water supply scheme	149,961
Allahabad Alfred Park water supply improvement scheme	5,607
Allahabad pipe line extension, Bai-ka-bagh	5,191
Allahabad George Town water supply extension	8,615

	Rs.
Meerut storm water drain improvement scheme	1,29,716
Meerut storm water drain alternative	2,87,568
Meerut storm water drain northern sewer scheme	53,218
Cawnpore A. B. road sewer and laying pipe line	81,585
Khurja supplementary drainage scheme	7,156
Lucknow raising the banks of settling tanks	11,696
Moradabad drainage scheme	49,640
Hapur water supply	42,479
Hapur flushing scheme	37,653
Brindaban drainage scheme	204,316
Cawnpore outfall sewer extension	87,759
Ahraura drainage scheme	54,036
Ballia drainage scheme for mains and sub-mains	89,880
Ballia drainage scheme for ordinary streets and drains	33,966
Mahalla meat market	2,161
Sitapur meat market	4,219
Hide curing godown standard plan	4,362

The following schemes were finally sanctioned during the year:—

Muttra drainage scheme	299,368
Jaspur Act XX towns drainage scheme	3,507
Khekra Act XX towns drainage scheme	15,354
Garhmuktesar Act XX towns drainage scheme	8,702
Mussoorie water supply improvements	61,700
Lucknow Hassanganj pipe distribution main	41,063
Agra water works improvements	134,363
Allahabad unfiltered water supply	149,961
Allahabad Alfred Park water supply improvements	6,607
Allahabad filtered water supply improvements	290,538

With a view to exercising a closer supervision of all the water works and effecting economies in their maintenance charges, Mr. H. J. Newson, Assistant Engineer, has been appointed to inspect them and to suggest such improvements as are considered necessary. He joined the department in January last and visited all the water works stations with the representative of Messrs. James Simpson & Co. in January and February. He was also sent to Meerut to enquire into the question of wastage of water at Dhobi Ghat and the shortage in the Civil Lines. It is anticipated that his appointment will result in considerable economies and improvements in the maintenance of water works in the province.

Mr. D. M. Cameron was also recently appointed for the purpose of fixing meters to prevent waste of water in the municipalities having water works. He joined this department in October last at Cawnpore. He has since gone to Benares where his services were required for fixing meters and as soon as he has completed this work there he will be sent to other municipalities for similar purposes.

It is now proposed to utilize tube wells at some places in these provinces to provide cheap water supplies for flushing, drinking and irrigation purposes. Contributions have been made by rich municipalities and the expenses at poorer places will be met from the grant made by the Sanitary Board. Trial borings have been started at four places under the supervision of Mr. E. W. Beveridge, Executive Engineer, and the results of actual tests are awaited. A large number of boring pipes and tools have been obtained and every endeavour is being made to make the experiment a success.

Operations in connection with the permanent water supply of Fyzabad were started in February and a 10 ft. masonry cylinder has been completed and sunk to a depth of 32 ft. and arrangements for sinking a permanent 9″ tube well are being made.

The work of the Sanitary Branch continued to increase during the year; applications for preparation of drainage or water works schemes are coming in from all parts of the provinces in large numbers but as trained staff for this sort of work is not available, it is difficult to keep pace with the demand on our services.

There are 10 projects under construction and about 50 schemes to be prepared and as it is necessary that each place concerned should be visited and the schemes prepared in consultation with the local officers, the entire province will be divided into three circles with their head-quarters, at convenient centres to enable the work to be more efficiently supervised. These circle offices will correspond direct with the Municipal Boards of their respective circles and will refer important matters to the Sanitary Engineer for orders. This arrangement will, it is hoped, help much in getting the work done with greater promptitude in future. One circle office has been opened at Saharanpur and another is being started at Cawnpore.

Dealing with the larger municipalities :—

Agra.—As the main channel of the river has unfortunately remained on the east bank, an expensive canal had to be maintained to bring water into the inlet wells. A project for certain improvements to the water works installation has been prepared and sanctioned and the work is in progress. The question of the shortage of water supply has been under consideration for sometime past and a special committee was appointed in September 1913, to investigate the matter. They have carefully gone into every detail and submitted a report on the subject and have made suggestions to improve the condition of the installation. The distribution mains are said to be too small and it is recommended that unless they are enlarged no further house connections should be allowed. Extra engine power is also required. The question of waste is also under consideration but apparently nothing can be done until the Board agree to charge consumers a suitable rent to defray the cost of extra staff and the upkeep of meters.

A comprehensive drainage scheme for the place is under preparation. The survey work is finished and the estimate is being prepared and will be sent to the Municipality as soon as it is completed. The sullage farm has continued to work satisfactorily and yielded an income of Rs. 8,750.

Allahabad.—New engines were erected in Allahabad and have commenced working. The new rising main will also be ready about the middle of May.

The storage capacity of the settling tanks have been increased by raising their banks and a project for certain other improvements has been sanctioned by Government.

The scheme for supply of unfiltered water for irrigating public gardens and the Alfred Park has been prepared and is at present under the consideration of the Sanitary Board. The boring operations are being carried out here and if they prove successful the necessity for using the filtered water for this purpose will be avoided.

Drainage works are still going on. Sub-main drains nos. 1, 2 and 3 and main drains nos. 3 and 4 have been completed and are ready for use. Inlet well, screening chamber, gravitation channel and emergency outlet leading to the river have been completed at the pumping station. Contracts for engines and pumps and the rising main have been concluded and it is expected that the whole of the pumping station and its equipment will be ready within a year. The execution of the Naini sullage farm scheme has been taken in hand. Surface drainage and street improvement works were begun in February last. The total amount spent up to the end of the year was Rs. 2,12,386.

Benares.—The work in connection with the construction of Deacon waste meter system is in hand. It is proposed to raise the banks of the settling tanks. An estimate amounting to Rs. 172,266 for erection of an experimental roughing filtration plant has been submitted to Government for sanction.

The river being very low at Benares this year the level of the water in the suction well at Bhadaini is 18 feet lower than it was in the previous year. It was therefore proposed to have a temporary pumping plant for pumping water from the river into the suction well. The matter was fully investigated and after consideration the municipality has been advised to lower the new pumps at Bhadaini about 7 feet and to have the old engines thoroughly repaired at once. This matter is still under consideration.

Drainage.—Good progress has been made in improving the drainage system of this place. A sum of Rs. 115,738 was spent during the year and the sewers in Pakka Mahal, Orderly Bazar, Haris Chandra Road and Assi to Dasaswamedh Ghat are still under construction.

Cawnpore.—The river receded more than 2 miles from the unfiltered station at Bhaironghat and consequently a channel had to be maintained to bring the water into the inlet well at a cost of Rs. 97,337. The new engines and pumps at Benajhabar and Bhaironghat stations have been taken over by the Municipality but a further test is to be made on those at the latter place.

The water works improvement scheme is nearing completion. The pumping plant is in operation. The new water tower is practically finished.

The connection of the mains and the venturi-meters at the pumping station was done, the linking up of the new water tower with the mains is in progress. The Puech Chabal filtration plant was in use during the whole of the year but as the results of tests made during 1913, were not considered satisfactory, it was settled by His Honour the Lieutenant-Governor that further tests were to be made from May to September 1914.

Drainage works.—In January last great inconvenience was caused by the failure of the sewage pump at the Parmat ghat low level pumping station owing to rags and other detritus going into the suctions. A centrifugal pump was installed and the whole of the sewage had to be temporarily diverted. An estimate for the extension of the outfall sewer was prepared by the Sanitary Engineer and has been sanctioned. No funds are yet available for this work. The town extension and comprehensive drainage schemes for the place are under preparation.

Lucknow.—The new boiler and engine are expected in November next and it is proposed to replace the old engines and pumps by new ones as soon as possible. It is anticipated that the saving on account of coal consumption alone will repay their cost in about 12 years.

Filter no. 2 was recharged with sand. A Wilkin's Patent Filter Outlet Regulator (Module) was installed on the occasion of the last Sanitary Conference. It has proved perfectly successful but it is rather expensive.

The banks of the settling tanks were raised.

The drainage system has worked quite satisfactorily and the sullage farm has given a very fair return considering its inadequate size.

Meerut.—The demand for filtered water for domestic purposes having much increased steps were taken to stop irrigating lawns in the Town Hall garden and notices were put upon stand posts to prevent waste of water which helped a great deal. The question of the selection of a suitable site for the balancing tank for storage of water is still under consideration.

Meerut Drainage Works.—The storm water drainage scheme has been prepared and sent to the municipality.

Mussoorie.—The main pumps at the Murray Springs still continue giving trouble. A flaw developed in one of the cranks which was replaced by one of heavier section. Trouble was also experienced owing to breaking of valves. The upkeep of the rope drive has also been heavy. The new pump at the John Mackinnon spring was started in August and has proved most satisfactory. It was stopped in November as the building had to be dismantled and reconstructed with sufficient accommodation for a duplicate pump and for an oil engine as a stand-by in place of the old steam pump which had been discarded.

Landaur Sanitation Scheme.—The work commenced in September last and the whole of the pushta work has been completed. The laying of the sewer pipes, gully pits and manholes are in hand and the surface drains are half completed. The total expenditure during the year amounted to Rs. 1,23,984.

Naini Tal.—The engines and boilers are in good order and steps are being taken to remove the smoke nuisance. All collecting reservoirs were cleaned twice during the year and kept in good condition. Endeavours are being made to use the surplus water from the combined main springs for flushing purposes by gravitation and thus effect a further saving in coal. Steps are also being taken to make small parts of the engine in the workshop instead of getting them from elsewhere. The scheme for certain further improvements to the water works installation has been sanctioned by Government and the work will be shortly taken in hand. The Jewell filter did not work satisfactorily and is to be overhauled by the firm that supplied it.

Jhansi.—The water works of the place have not been completed yet and it is proposed to make the contractors replace the pumps and boilers installed by them as they have been proved to be incapable of discharging the required quantity of water.

The drainage scheme has not yet been taken in hand for want of funds. It is to be split up in parts so that it can be done piecemeal.

Mirzapur.—The water works have been constructed by Public Works department at a total cost of Rs. 598,492 but have not been made over to the municipality yet.

The machinery at all water works stations worked well throughout the year and the quality of water supplied was excellent. The demand for water has considerably increased everywhere and with a view to keeping pace with it, necessary additions and improvements have been or are being made. There was a burst on 28″ water main in Cawnpore which caused the stoppage of water supply for 28 hours. Prompt action was taken to put it right. Two accidents occurred at Benares but fortunately the supply of water was not stopped there.

The construction of drainage works at Almora, Kanauj, Khurja and Hapur have lately been finished and those at Fyzabad, Landaur, Rikhikesh and Allahabad are still going on. The work at Bahraich has just commenced and that at Shahganj and Jaunpur will shortly be started. In Muttra, both the water and the drainage works will be carried out simultaneously. They will be put in hand shortly. The drainage works at Moradabad were finished sometime ago but certain minor defects necessitated a supplementary scheme which has recently been prepared and sent to the municipality. They also want a project to be prepared for the supply of water for flushing and drinking purposes and this will be taken in hand as soon as the scheme for Aligarh, Saharanpur and Hardwar are completed in addition to those mentioned below.

The following schemes are under preparation :—

Agra drainage scheme.
Cawnpore ,, ,,
Muktesar ,, ,,
Pandohi diversion drainage scheme.
Ramnagar drainage scheme.
Badshahpur ,, ,,
Machhlishahr ,, ,,
Aligarh ,, ,,
Saharanpur ,, and waterworks schemes.
Lakhimpur water works scheme.
Benares raised reservoir.
Lucknow Chhatar Manzil improvement scheme.
Hardwar water supply scheme.
Bareilly drainage scheme.
Pilibhit ,, ,,
Baraut ,, ,,

V. GILES, CAPTAIN, R.E.,
Sanitary Engineer to Government,
United Provinces.

APPENDICES.

APPENDIX

UNITED PROVINCES

Statement of operations

Particulars.	Agra.	Allahabad.	Benares.
Population.			
By Census of 1911 in municipality ...	163,935	159,701	199,868
Ditto cantonments ...	21,514	11,996	3,936
Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868
Consumption of water.			
During the year including cantonments, gallons	1,247,710,600	1,040,158,511	1,731,030,282
Daily average including cantonments ,,	3,418,385	2,849,749	4,742,548
Maximum daily average in any one month ,,	3,932,461	3,368,374	6,624,285
Water used for irrigation and manufacturing purposes, gallons	133,521,571	185,953,350	12,717,000
Water used for domestic purposes, ,,	1,114,189,029	854,205,161	1,718,313,282
Water consumed per capita ,,	16·46	13·63	23·09
Daily average for cantonments alone ,,	248,071	156,122	3,361
Number of house connections during 1913-14	105	233	495
Number of metered connections	133	340	...
Annual receipts and charges.			
Maintenance charges ... ... Rs.	95,657	103,287	93,721
Cost per 1,000 gallons consumed ... Annas.	1·23	1·44	·86
Cost per 1,000 gallons per 100 feet lift ...	·641	·93	·58
Cost of water per 1,000 gallons including interest and sinking fund charges.	2·52	3·2	1·47
Lift of pump.			
From river to settling tanks	45′ head	94′	84·64′
From filtered water pumps to town distribution	147′ ,,	76′	61·45′
Total lift ...	192′ ,,	170′	146·09′
Income from water works.			
Water rate recovered during the year Rs.	84,419	106,536	126,090
Sale of water and other receipts ,,	32,794	53,322	6,522
Total income ,,	117,213	159,858	132,612

No. I.

WATER WORKS.

during the year 1913-14.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
173,973	240,016	76,351	11,985	16,788
21,517	19,782	39,876	2,511	1,239
173,973	259,798	116,227	11,000	18,027
1,597,879,831	1,213,453,400	425,398,151	35,400,648	29,804,205
4,377,753	3,350,000	1,165,474	96,988	81,656
5,531,599	4,200,000	1,671,155	125,701	160,698
368,224,314	183,402,000	11,558,470	Nil ...	403,862
1,229,655,517	1,030,051,400	413,839,681	35,400,648	29,400,343
25·16	12·7	9·75	8·81	5·51
Nil ...	371,000	417,475	1,371	3,307
3,157	397	685	163	213
683	351	36	164	209
242,356	91,838	27,401	21,542	33,820
2·43	1·201	1·03	9·75	Rs. 1·13
1·78	·501	·66	·57	Rs. 0·15
3·32	2·32	2·82	Rs. 1·28	Rs. 1·906
86·45′	129′	15·16′	Nil ...	Nil ...
58·25′	77′	141·13′	Main 1,700′ auxiliary 600 ft.	Tonnochy 1,160′ Ayar patta 1,093′ Pilgrim 240′
144·70′	206′	156·29′	1,700′	2,493′
Nil ...	37,221	Nil ...	Nil ...	28,043
96,194	105,408	38,002	11,273	12,064
96,194	142,629	38,002	11,273	40,107

APPENDIX No. II.

Annual maintenance accounts of water works in the United Provinces during the year 1913-14.

Nature of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. *Establishment*—								
(*a*) Permanent establishment.	22,589	27,000	28,992	28,672	25,833	10,867	11,488	10,141
(*b*) Office contingencies	1,359	500	1,435	1,941	636	5,669	...	129
(*c*) Rents	662	1,526	280	...	440	210	...	500
2. *Pumping*—								
(*a*) Coal	42,063	31,111	31,854	54,785	43,199	858	...	13,134
(*b*) Oil and waste ...	3,124	2,000	4,562	5,167	1,755	597	900	648
(*c*) Other stores ...	3,146	6,014	4,498	7,459	3,108	2,888	2,994	1,195
3. *Intake*—								
(*a*) Training river ...	...	...	...	97,337	...	...	...	...
(*b*) Clearing channels and wells.	4,100	200	256	644	...	50	...	18
4. *Settling tanks and filters.*								
(*a*) Clearing settling tanks	264	2,250	1,956	1,562	3,288	50	...	...
(*b*) Clearing and renewing filter beds.	1,862	1,500	2,501	7,241	46	2,446	...	...
(*c*) Purchase of sand ...	11,178	3,000	3,497	7,324	4,096	...	...	...
(*d*) Filter House ...	...	...	...	...	...	...	...	417
(*e*) Alumino ferric ...	...	...	9	...	...	...	...	...
5. *Distribution*—								
(*a*) Pipes and fittings ...	959	15,649	3,240	4,557	1,780	994	610	2,769
(*b*) Meters ...	1,211	2,497	...	10,956	2,690	...	296	1,655
6. *Repairs*—								
(*a*) To tanks ...	274	100	323	...	...	333	192	98
(*b*) To buildings and grounds.	1,564	990	1,499	1,391	472	463	299	204
(*c*) To machinery ...	1,147	8,000	8,070	5,565	4,227	1,866	4,500	1,637
(*d*) To rising main ...	...	...	494	...	...	...	...	...
7. *Water analysis*—	154	950	254	7,755	268	110	263	12,75
Total ...	95,656	103,287	93,721	242,356	91,838	27,401	21,542	33,820

APPENDIX No. III.

Statement showing the initial capital cost of subsequent extensions and improvements incurred on water works in the United Provinces up to the end of 31st March 1914.

Water works stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extensions during the year 1913-14.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	6,69,016	62,190	19,01,967
Allahabad	16,24,061	2,33,786	1,79,319	20,87,166
Benares	25,61,881	5,01,662	21,061	30,84,604
Cawnpore	14,44,570	6,70,727	2,13,862	23,29,159
Lucknow	15,15,736	4,50,782	49,927	20,16,445
Meerut	7,51,710	37,123	4,537	7,93,370
Mussoorie	1,14,014	17,996	9,305	1,41,315
Naini Tal	2,47,000	3,40,339	2,439	5,89,778

APPENDIX No. IV.

Statement showing rate of filtration and results of water works of the United Provinces during the year 1913-14.

Municipalities.	Rate of filtration per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.	
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.
Agra	38	25	29	1	...	1	49	Nil.
Allahabad ...	74	3	33	4	...	4	346	160
Benares ...	43	25	31	2	...	2	293	1
Cawnpore ...	75	13	44	...	...	...	82	6
Lucknow ...	56	3	26	1	...	1	383	23
Meerut ...	34	11	21	2	...	2	224	1
Mussoorie ...	...	...	...	...	...	...	...	...
Naini Tal ...	...	...	...	1	...	1	...	...

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising

Particulars.	Agra.	Allahabad.	Benares.
1. Consumption of water per capita in gallons.	16·46	13·63	23·09
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868
3. Water used for irrigating and manufacturing purposes.	133,521,571	185,953,350	12,717,000
4. Power of pumps per hour in gallons at river.	2 Horizontal pumps each— Designed for 84,000 Maximum ... 96,000 Average ... 78,000 1 Worthington low duty pump. Designed for 120,000 Maximum ... 132,000 Average ... 102,000	Designed for 126,000 Maximum ... 154,961 Average ... 114,862	Designed for 252,000 Maximum ... 189,140 Average ... 172,383 1 Worthington high Duty pumping engine designed for 500,000 gallons.
5. *Horse power each engine is designed for.*	2 *Horizontal pumps of* 28 horse power each. 1 Worthington low duty engine of 31 horse power.	2 *Engines of 102 horse* power each.	2 Horizontal engines 141 horse power each. 1 Worthington high duty engine.
6. Power of pumps per hour in gallons at filter.	2 Beam engines each... Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1 High duty Worthington. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	Designed for 223,300 Maximum ... 265,000 Average ... 183,453	Designed for 462,000 Maximum ... 455,809 Average ... 375,150
7. Horse power each engine is designed for.	1 High duty Worthington of 130 horse power. 2 Beam engines of 100 horse power each.	2 Engines of 135 horse power each.	4 Beam engines of 114 horse power each.
8. Number of rising mains ...	2	1	2
9. Length of rising mains ...	2·5 and 1·75 miles respectively.	1·9 *miles*	·82 and ·94 miles respectively, i.e.— Old rising main 4,727′ New „ „ 4,100′
10. Size of rising mains ...	28″ and 18″	20″	Both 24″
11. Number of settling tanks ...	5	3	3
12. Size of settling tanks ...	Each 266′ × 151′ Capacity of each 2,200,000 gallons.	Each 280′ × 180′ Capacity of nos. 1 and 3=2,733,065 gallons, and that of no. 2 =2,819,243 gallons.	(288′ + 20′) × (238′ + 20′) × 15′. Capacity of nos. 1 and 3=6,436,120 gallons, and that of no. 2. =6,508,927 gallons.
13. Number of filters ...	7	6	8
14. Size of filters	Each 200′ × 10′	200′ × 100′	200′ × 100′ × 6′–4½″
15. Number of C. W. reservoirs...	3	2	2
16. Size of C. W. reservoirs ...	103′ × 105′ × 10′	Each 160′ × 103·3′ × 12′ Capacity ... 1,168,700	(178′–4″) × (148′–4″) × (16′–1″). Capacity 1,879,631 gallons.
17. Number of service reservoirs or standpipes.	One tap standpost 155 Two „ „ ... 63 Four „ „ ... 43 Road watering 25 stand pipe.	One tap standpost 134 Two „ „ ... 57 Four „ „ ... 80 Waste not cocks ... 13 Push cocks ... 12 Wall boxes ... 7 Bib cocks ... 6 Generally of ¾″ size.	243 one-tap standposts, 105 two-tap stand posts, 79 four-tap standposts.

No. V.

mains, &c., in the water works of the United Provinces for 1913-14.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
25·16	12·7	9·75	8·81	5·51
173,973	259,798	116,227	Average per year ... *11,000	*18,027
338,224,314	183,402,000	11,558,470	...	403,862
Two pumps each— Designed for 187,500 gallons. Maximum 187,500 gallons. Average 165,000 gallons.	Designed for 187,500 Maximum 188,237 Average 178,517	Designed for 72,000 Maximum 61,985 Average 37,037	Designed for 10,800 Average 10,920 Maximum not known.	Lake station 14,355 Baranadi Springs } 13,326
2 Engines of 86 horse power each.	2 Engines of 130 horse power each.	1 Engine of 26 horse power. 2 Turbines each of 90 horse power.	Each motor pump designed for 150 horse power.	31 horse power.
Two pumps each— Designed for 187,500 Maximum 187,500 Average 174,375	Designed for 180,000 Maximum 180,000 Average 175,000	Designed for 66,000 Maximum 50,611 Average 30,327	... ...	
2 Engines of 80 horse power each.	2 Engines of 110 horse power each.	...	...	
2	1	1	1	4
1·32 miles	3·5 miles	15" main=38,292' 13" main= 8,550'	1·18 miles	Ayarpatta ·93 miles. Tonnochy ·66 „ Pilgrim ·34 „ Lake ·19 „
Each 20" dia.	20"	13" and 15"	5"	4", 3½", 3", 4"
3	3	3	...	...
Each 355'×255' capacity 3 million gallons.	250'×200'	100'×60'×11'	...	...
7	7	4	...	1 Jewel filter 12' dia.
200'×100'	200'×100'	150'×100'	...	...
2	2	1	4	5
Each 135'×106'—8" ×12' deep. Capacity of each 953,300 gallons.	Each 105'×107'	48'×52½'	2×40'×25'×8' 1×80'×24'×6' 1×30'×20'×8'	...
94—4 tap standposts 53—2 ditto 80—1 ditto	171 one-tap standposts; 227 two-tap standposts.	40 one-tap standposts of ¾", 93 two-tap standposts of ¾"·3 wall fountains 4 taps of ½".	12 iron service tanks 32 stand-pipes of 2 taps.	64 service tanks, 27 standposts.
150'—6" high × 36' dia.				

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* Summer population.

Details of pumps, filters, tanks, reservoires, rising

Particulars.	Agra.	Allahabad.	Benares.
18. Size of service reservoir ... 2 Circular balancing tanks...	66′ dia. × 11′ – 4″ deep 20′ dia. × 50′ deep each.	60′ dia. × 11′ deep ...	60′ dia. × 15′ deep Capacity 260,000 gallons.
19. Lift of pumps from river to settling tanks.	45 feet head	94′	84·64′
20. Lift of pumps from filter water pump to town distribution.	147 „	76′	61·45′
21. Cost of supplying water per 1,000 gallons.	1·23 annas	1·44 annas	·86 annas
22. Cost of supplying water per 100′ lift.	·641 „	·93 „	·58 „

[illegible]o. V.

mains, &c., in the water works of the United Provinces for 1913-14—(concluded).

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
Holds 320,000 gallons	66′ × 12′	2—Each 25′ × 34′	2 × 40′ × 25′ × 8′ 1 × 80′ × 24′ × 6′ 1 × 30′ × 20′ × 8′	28 round service tanks 3′ × 3′, 28 round service tanks 2′—8″ × 3′, 8 square tanks 6′ × 8′ × 4′.
86·45′	129′	15·16′	11·5′ (*a*)	From collecting reservior to— *Tonnochy* ... 1,160′ Ayarpatta ... 1,093′ Pilgrim ... 240′
58·25′	77′	141·13′	17·00′ (*b*)	...
2·43 annas	1·201 annas	1·03 annas	9·75 annas	Re. 1·13
1·78 „	·501 „	·66 „	·57 „	„ ·15

(*a*) Suction lift from collecting reservoir to pump.

(*b*) Lift from pump to town distribution.

APPENDIX VI.

Detailed statement showing the expenditure incurred on original works of a sanitary nature, executed under the supervision of Sanitary Engineer during the year 1913-14.

Name of municipality.	Expenditure incurred on—			Total expenditure.
	Water works.	Drainage works.	Other works.	
	Rs.	Rs.	Rs.	Rs.
Agra	62,190	1,545	1,030	64,765
Allahabad	1,79,319	1,69,963	...	3,49,282
Benares	21,061	1,15,738	...	1,36,799
Cawnpore	2,13,862	...	...	2,13,862
Lucknow	49,927	...	12,181	62,108
Meerut	4,537	...	...	4,537
Mussoorie	9,305	1,23,984	...	1,33,289
Naini Tal	2,439	...	...	2,439
Khurja	...	72,636	...	72,636
Hapur	...	52,618	...	52,618
Fyzabad	...	34,151	...	34,151
Almora	...	17,000	...	17,000
Kanauj	...	992	...	992
Mirzapur	1,02,213	...	...	1,02,213
Lakhimpur	...	3,662	...	3,662
Dehra Dun	...	624	...	624
Garhmukhtesar	...	4,628	...	4,628
Khekra	...	2,029	...	2,029
Total ...	6,44,853	5,99,570	13,211	12,57,634

APPENDIX No. VII.

Comparative statement of working expenses of water works schemes in the United Provinces for 1913-14.

No.	Name of water works.	Class of work, gravitation or pumping.	Coal consumption per 1,000 feet, gallons.	Price of coal per ton.	Total lift including friction.	Percentage of charges for—			Average consumption in gallons per head per day throughout the year.	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet, gallons, for pumping scheme.	Cost of maintenance per head of population.	Cost of pumping per 1,000 feet gallons.	Income per head of population.	Remarks.
						Establishment.	Coal.	Other charges.							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Lbs.	Rs. a. p.	Feet.					As.	As.	As.	As.	As.	
	Agra ...	Pumping ...	·023	8 0 0	192	23·62	43·97	32·41	16·46	1·37	·006	8·25	·003	10·113	
	Allahabad	Do. ...	·044	10 8 0	170	26·00	30·00	44·00	13·63	1·44	·009	9·58	·007	14·91	
	Benares ...	Do. ...	·026	10 8 0	146	30·93	33·98	35·09	23·09	·86	·005	7·35	·002	10·41	
	Cawnpore	Do. ...	·033	11 10 4	144·70	12·63	22·61	64·76	25·16	2·43	·018	22·28	·005	8·8	
	Lucknow ...	Do. ...	·020	13 0 0	206	28·30	47·00	24·70	12·7	1·20	·20	5·6	·004	8·70	
	Meerut ...	Do. ...	Turbine worked by water power.	Nil	156·29	39·66	7·66	52·68	9·75	1·03	·006	3·77	·005	5·23	
	Mussoorie	Do. ...	Nil	Nil	175·3	50·7	Nil	49·3	8·81	9·75	5·74	Rs. 1·96	4·25	Rs. 1·02	The pumps are driven by electric power and not by steam power.
	Naini Tal	Pumping and gravitation supply.	·502	Coal at Rs. 30 Wood at Rs. 19 per 100 maunds.	Tonnochy 1,160 ft. Ayarpatta 1,093 ft. Pilgrim 240 ft.	29·99	38·83	31·18	5·51	Rs. 1·13	Rs. ·0025	Rs. 1·87	Rs. ·0014	Rs. 2·2	

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EIGHTEENTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES.

SEAL OF MUNICIPAL BOARD NAINI TAL

FOR THE YEAR ENDING 31st MARCH 1913.

ALLAHABAD:
PRINTED BY F. LUKER, SUPDT., GOVERNMENT PRESS, UNITED PROVINCES.
1913.

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1913.

Eighteenth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending the 31st March 1913.

THE office of the Sanitary Engineer to Government was filled by me throughout the year. From 18th March to 4th May 1912, I held the post of Sanitary Engineer to Government in addition to the post of Under-Secretary to Government and Personal Assistant to the Chief Engineer. In April I was deputed as a member of a committee for the preparation of anti-malarial schemes for Saharanpur, Nagina and Kosi. From 18th September to 13th November I held the post of Superintending Engineer, 2nd circle, Buildings and Roads branch, in addition to the post of Sanitary Engineer. From 11th November to 15th November, I attended the Sanitary Conference at Madras.

Mr. H. E. Parker, who had been working as Assistant Sanitary Engineer in this office since January 1907 was transferred in March 1912 and has since been deputed to Delhi for work there. No one was sent to replace Mr. Parker until the 31st of August.

The transfer of Mr. Parker left me without any assistant for the greater part of the year and this added very considerably to the difficulty in disposing of current work. Mr. Nandi, besides doing his own work, helped with the Assistant Sanitary Engineer's work during the period which elapsed between Mr. Parker's transfer and Mr. Karm Chand's arrival. Mr. Karm Chand joined the office on the 31st August and considering he was new to the work when he came and the very short time he has been with me, he has already a very fair grasp of the requirements.

The rest of my technical staff consisted of surveyors and draftsmen of whom there were on an average 15 surveyors and 12 draftsmen employed throughout the year. This staff requires strengthening badly.

The following Engineer officers were employed on the construction of Sanitary works under the Public Works department :—

Mr. H. J. Amoore, Assistant Engineer, on the Mirzapur water works.

Mr. R. Miles, temporary Assistant Engineer, was first on the Firozabad drainage works and subsequently on the Khurja and Hapur drainage works.

Mr. G. E. Rhodes, Assistant Engineer, on the Allahabad drainage works.

Mr. Hubbard, temporary Assistant Engineer, was on the Moradabad drainage works and subsequently for some time on the Allahabad drainage works. In January he was sent to Saharanpur.

At the end of the official year under report when large sanitary grants were announced, I obtained sanction to engage a few men with good engineering and upper subordinates qualifications on small salaries with a view of giving them a training in Sanitary work. Some half a dozen men have been employed and are under training, but as this relates to the current year's work I will say nothing further about them except that on the whole, the experiment promises to be a success.

The following large schemes were finally sanctioned during the year :—

	Rs.
(1) Aligarh drainage scheme	6,30,414
(2) Landour drainage scheme	2,22,564
(3) Bahraich drainage scheme	3,50,347
(4) Shahganj drainage scheme	69,848
(5) Altering high tension lines Mussooree	35,000
(6) Altering the low tension lines Mussooree	70,000
(7) Paving Markhamganj, Dhampur	14,241

The following schemes were prepared and sent to Chairmen, Municipal Boards for disposal, though not finally sanctioned during the year :—

	Rs.
(1) Muttra drainage works	2,99,368
(2) Jaunpur drainage works	54,807
(3) Diverting railway sewage, Lucknow	12,961
(4) Generalganj sewage, Cawnpore	11,107
(5) Khekra	11,974
(6) Garhmuktesar	8,752
(8) Naini Tal water supply improvements	34,032
(9) Allahabad water supply improvements	3,37,371
(10) Agra water supply extensions	1,12,000
(11) Improvements to Nagina drainage (two schemes)	10,623

The following schemes were practically completed though not finally disposed of during the year :—

	Rs.
(1) Brindaban drainage	2,27,000
(2) Ahraura drainage	47,000
(3) Dehra drainage	55,000
(4) Baraut drainage	21,208
(5) Revised scheme Ballia drainage	80,000
(6) Revised scheme Etawah drainage	3,69,000
(7) Ghaziabad flushing	20,000

The following large schemes were started and are under preparation :—

(1) Agra drainage scheme ... ...
(2) Cawnpore drainage and town extension scheme ...
(3) Unfiltered water-supply, Allahabad ... ...
(4) Sullage disposal, Lucknow ... ...
(5) Water-supply, Saharanpur ... ...
(6) Ditto Hardwar ... ...
(7) Ditto Muttra ... ...
(8) Ditto Fyzabad ... ...
(9) Allahabad sullage farm and pumping plant estimate ...

Enlarged maps of Amroha and Chandausi were prepared and surveys of Badshahpur, Machlishahr, Sandila, Bisalpur, Kunch and Rasra were in hand.

The following places were visited by me during the year. Several visits being paid to some of the larger municipalities in connection with their works.

Allahabad, Agra, Benares, Cawnpore, Meerut, Mussooree, Naini Tal, Dehra, Landour, Fyzabad, Saharanpur, Kosi, Nagina, Moradabad, Aligarh, Muttra, Brindaban, Khurja, Hapur, Bhola, Ajodhya and Hardwar.

My Assistants, Mr. Karm Chand and Mr. Nandi, visited the following places in addition to most of the abovementioned places :—

Garhmuktesar, Shahabad, Sandila, Anupshahr, Hardoi, Pilibhit, Bisalpur, Bijnor, Jalesar, Baraut, Kunch, Rasra, Ghaziabad, Badshahpur, Kaimganj, Nimsar, Gola, Kanauj, Shahganj, Ballia and Khekra.

Agra, Allahabad, Benares, Cawnpore, Lucknow, Meerut, Mussooree, Naini Tal.

The eight large water works stations mentioned in the margin were inspected by me. There was only one serious breakdown at Allahabad which is noticed separately under the Allahabad works.

The filtered water has been kept up to a high state of purity, but in most of these stations the demand is now in excess of the supply and extensions and improvements are everywhere either contemplated or in hand.

The total capital cost of these water works amounts roughly to 125 lakhs and when the works at present in hand for improving and extending these supplies are completed, this total will be raised to close on 1½ crores of rupees. The total amount spent on the maintenance of these water supplies comes to between 5½ to 6 lakhs yearly. The standards of efficiency at present maintained are fairly high, but further improvements are necessary. Printed notes and instructions have been prepared by the Sanitary Engineer and sent to all Municipal and water works Engineers pointing out in what directions improvements and economies might be effected, but more supervising officers are needed to visit these stations at frequent intervals and set standards of efficiency and economy and see that these standards are being worked up to, they should also see that careful records are maintained of the exact expenditure under each separate head for future reference.

If, as a result of this closer supervision, only 5 to 10 per cent. were saved in the maintenance charges, this would amount to Rs. 30,000 to Rs. 60,000 a year or Rs. 2,500 to Rs. 5,000 a month. This would more than cover the cost of the staff required and a much higher standard of efficiency and economy could be maintained.

There are several important questions in regard to these water works which require careful looking into. Such questions as—"District waste metering," "House connections and metering," "Inequalities in the supply and distribution;" and "Supply of water for gardens and irrigation;" all need enquiring into. Some progress has been made with regard to the above, for instance Cawnpore, Benares, Mirzapur and Muttra are to be fitted with district waste meters. An unfiltered water scheme has been got out for the irrigation of gardens and lawns at Allahabad, and some forms of quantity supplying taps are being tested, but a good deal still remains to be done which cannot be taken up till the supervising staff of the Sanitary Engineer's office is increased. Very little experimental work either on water or sewage purification can be attempted till the staff is strengthened.

Perforated tube wells.—With the Chief Engineer's permission, I visited Amritsar to see the tube wells there in actual work. Where suitable strata are available these tube wells, constructed at small cost, enable large quantities of water to be obtained from the sub-soil. There is no doubt that these wells will be most useful in certain parts of these provinces for providing cheap water supplies for flushing and drinking purposes and also for irrigation.

At present we have proposals under preparation for utilizing tube wells at about a dozen different places in these provinces. There has been some delay in getting the necessary boring pipes and tools, but arrangements have been made for these and also for a staff of borers and we will soon be in a position to make a start on some of these schemes. There is, however, a great deal still left to be done in working out details of these schemes and in making trial borings and for this also more superior staff is badly needed to push on the work.

Staff.—The question of organizing a proper engineering staff for the Sanitary branch is still under consideration. The Buildings and Roads branch of the Public Works department are supposed to provide the Sanitary branch with Engineers, but they have not sufficient men for their own requirements and temporary men have to be employed to carry on the ordinary routine work of Buildings and Roads branch. With such a source of supply for establishment to depend on it is not surprising to find that the Sanitary Engineer has practically no Engineering staff under him. It will take quite five to ten years before the Buildings and Roads staff can be brought up to full strength and after that Public Works department men may be available for sanitary work in the numbers required.

It will thus be seen that under these circumstances special recruitment of Engineers for sanitary work must be resorted to for some years, until more men from the regular Public Works department list are available.

Something should be done as soon as possible to meet the requirements of the Sanitary Engineer's branch. Delays or inadequate supervision when dealing with urgent and important municipal schemes for water supplies or drainage may often have serious and unfortunate consequences for the public and an attempt should be made to safeguard these interests as far as possible.

General.—The Sanitary Conference held at Madras last year did a great deal to stimulate interest in sanitation and to spread information as to what was being done regarding sanitary works in different parts of India. It is understood that this year's Sanitary Conference will be held at Lucknow and it should be of special interest to the people of these provinces. The large grants made for sanitation at the beginning of this year caused no little stir in municipal centres when the chance of funds being available to help in carrying out sanitary reforms was realised and a number of fresh proposals for expenditure on sanitary works were received. The relief of Act XX Towns and municipalities from police charges and the addition to the District Boards' funds of the local cess has also helped to furnish funds some of which it is intended to utilise on urgent sanitary reforms. Quite a number of requests for drainage schemes for the smaller towns have lately come in.

From the description of the past year's work given below it will be seen that a great deal of work has been got through during the year with a very small staff but the demands from these Provinces for sanitary works and estimates are growing so rapidly that it has been as much as this staff could do to try and keep pace with the most urgent of these demands only. The necessity for strengthening the staff was recognised last year but apparently nothing could be done. I was promised a second Assistant Engineer (Mr. Hoey) in October. For some reason when the time came he could not be spared, and he is now on 6 months' leave, so instead of having two Assistant Engineers under me last year, for half the year I had none, and later on one only, and he was new to the work. Under such circumstances delays were unavoidable and the position has been most unsatisfactory to every one concerned. So far, in spite of representations made, the question of improving the Sanitary Engineering branch has not received the consideration it deserves. But I have reason to hope that before the next Sanitary Engineer's report comes to be written this question will be taken up and adequately dealt with and that a suitable cadre for a properly organised engineering establishment for sanitary work will be sanctioned.

The principal works undertaken during the year are detailed below :—

Agra water supply.—The two new standpost towers to hold 100,000 gallons each near the Thomason Hospital which were started last year have been completed and brought into use. The expenditure up to date has been Rs. 30,722 and has been met from the Government grant of Rs. 60,000. Two new Diesel Oil Engines direct coupled to centrifugal pumps have been ordered from James Simpson and Co. to replace the old three-throw pumps for the unfiltered supply ; these are expected shortly and will be erected during the coming cold weather. Estimates have been prepared for raising the height of settling tanks so as to increase their storage capacity. A new rising main has also to be put in and the pipe connections between the settling tanks and filters and between the filters and the clear water reservoirs are to be altered. These proposals have been approved by the Municipal and Sanitary Boards and as funds are available from a Government grant work on these will be started shortly. Tenders are also being called for with a view of putting in some form of roughing filters at Agra so as to improve and increase the output of filtered water.

Other urgent requirements are three Venturi meters and a new Economiser. Some alterations are also needed in the supply mains to insure a more equal distribution of the filtered water and to give better pressures in outlying areas. An additional grant of one lakh of rupees has been given by Government to help towards carrying out these works, and it is hoped that something will be done shortly to put the water supply of Agra on a more satisfactory footing.

Agra drainage works:—A scheme is under preparation for improving the drainage of Agra city. Surveys were started last cold weather and levels are now being taken. The survey and levels will be completed by October when a comprehensive drainage scheme will be drawn out. A contribution of one lakh of rupees has already been made by Government towards the cost of this work.

Agra sullage farm.—This farm has continued to work satisfactorily. The lease for 1913-14 sold for Rs. 8,500 or Rs. 2,459 more than in the previous year. An area of one acre 3 roods and 21 poles was washed away by erosion of the Jumna during the year.

Allahabad water supply.—Considerable difficulty was experienced in Allahabad during the summer of 1912 in getting a sufficient supply of unfiltered water from the engines at Karela Bagh and for about two months, from the middle of May to the middle of July, the use of water for road watering and irrigation had to be stopped and the hours during which water was supplied had to be reduced. Since July 1912 the full demand has been met.

Proposals for increasing the water supply at Allahabad have been approved of. A new engine for Karela Bagh was ordered through Messrs. Simpson and Co. and is now under erection. Some delay on the part of the engine house contractors in getting the engine house finished in time prevented the new engine being ready for use before the hot weather and in order to guard against a shortage of supply this summer and enable repairs to be done, two temporary pumps were obtained from Messrs. Simpson and Co. on hire and erected and they have proved quite useful. The old engines at Karela Bagh have, however, worked much better this year and with proper care and attention there should be no further difficulty about the unfiltered water at Allahabad. When the new engine now under erection is running, the old engines will be taken in hand one at a time and thoroughly overhauled and put in order.

The estimates for improving the water supply of Allahabad besides providing for a new engine allowed for the construction of a new filter, the raising of the settling tanks so as to give more storage capacity and the provision of a new 20″ rising main. Most of this work has now been completed, the rising main alone remains to be done. Tenders for this main have been called for and the work will be given out shortly.

A sum of Rs. 20,000 was allotted by the Sanitary Board for the provision of drivers' quarters and two Venturi meters. One of the drivers' quarters have been finished and one of the Venturi meters has been erected, the second Venturi meter will be put up as soon as the new rising main is finished. A further grant of Rs. 34,000 was allotted by the Sanitary Board for alterations to the old engines and the supply of spare parts for these engines. These spare parts have been ordered and the alterations to the engines will be taken in hand as soon as the new engine is working satisfactorily.

Allahabad drainage scheme.—The total estimate for the Allahabad drainage scheme comes to over sixteen lakhs of rupees. About four lakhs worth of work has been taken up in the area which lies between the East Indian Railway line and the river and includes the main portion of the city of Allahabad. The work to be done consists of the construction of the main sewers with their sub-mains and a pumping station for pumping the sullage across the Jumna and provision of a sullage farm at Naini. The Municipal Board were given four lakhs of rupees by Government for this work and a further grant of one to one and a half lakhs will probably be made in order to complete this portion of the scheme. When these main drains are completed the Municipal Board will have to provide funds for taking up the block drainage. A separate public works sub-division has been formed for this work with Mr. G. E. Rhodes, Assistant Engineer, in charge. Good progress has been made on the construction of these sewers, the erection of the engine house and the purchase of the machinery has however been somewhat delayed owing to the difficulty experienced in getting sanction from the East Indian Railway Company to take the sullage pipe across the Jumna bridge. This point is practically settled and we are now in a position to start work on this portion of the scheme and push on with it.

Allahabad unfiltered water scheme.—As there is a large demand for water for irrigation purposes for the gardens and lawns of the larger public buildings and institutions at Allahabad, a scheme is being drawn out for an unfiltered supply of about one and a half million gallons per day for this purpose. This supply will relieve the demand for filtered water to a considerable extent and allow of filtered water being more freely supplied for domestic purposes. A grant of Rs. 50,000 has been promised by Government for this work and if the experiment with tube wells is a success we should be in a position to start work on this scheme next year.

Benares drainage works.—The following important works which were financed either partly or wholly from grants received from the Sanitary Board were carried out during this year.

(1) *A new intercepting pipe sewer*—Was constructed between Dasaswamedh Ghat and Gau Ghat, this intercepts all the drainage coming into the river between these two points. This has been a difficult bit of work to do, but it has been very successfully handled by Mr. Bailly, the Municipal Engineer. The sewer is completed and in working order, only a few connections remain to be made. The total cost of the work up to date has been Rs. 74,354 against an estimate of Rs. 89,239.

(2) *Drainage of the pakka mahals.*—Slow but steady progress has been made in dealing with the insanitary condition of the drains in this area. The amount allotted by the Sanitary Board could not have been spent to better advantage. The expenditure for the year was Rs. 14,933, making the total expenditure up to date Rs. 38,616. The old drains in the pakka mahals under the pavements in narrow lanes can best be described as elongated cesspools. They are generally very deep and contain several feet of sullage and putrifying matter at the bottom. These drains are being remodeled and given proper gradients, but owing to the unsavoury nature of the work and restricted area for working in the progress is necessarily slow. The work is very important and should be pushed through to completion and not stopped till the whole area has been properly dealt with. Three or four more areas remain to be done and it may be possible to take them up this year.

(3) *Orderly bazar sewer.*—The construction of this sewer was taken up last summer, about half of it has been completed. The difficult portion over the Berna bridge still remains to be done. The sewer intercepts most of the sullage which now finds its way into the Berna and will be a very useful work when completed. The expenditure up to date was Rs. 29,419 against an estimate of Rs. 68,912.

(4) *Harish Chandra and Masan Ghat sewer.*—Another important work undertaken was the construction of this new road with its intercepting sewer. This new sewer intercepts all the sullage in this

area which formerly found its way into the Ganges, the flood water, however, will still flow into the Ganges as before, but the sullage will be taken into the main sewer. The construction of this road has greatly improved this locality and the building sites on the road have sold quite well. This important scheme has been carried through at very little cost to the municipality. The total estimated cost of this work was Rs. 68,650.

Many other very useful minor works were carried out from Municipal funds. Among these may be mentioned the Sondya Lane storm water drain, new shops at Bisheshwarganj, the Victoria Park scheme and the construction of kerb and channel drains along several roads. This shows that the interests of Benares as regards sanitation are receiving close attention from the local authorities.

Benares water works.—Both water works stations were maintained in good and efficient order throughout the year. The question of providing an increased supply of filtered water for Benares has been under consideration for some time. The amount of filtered water used at Benares is greater than that used at any other station in the United Provinces and there is very little doubt that the introduction of a District waste-meter system is badly needed. The estimate for this has been prepared and funds have been given by the Government, so that the work will soon be put in hand. Two or three new boilers are urgently needed at the filtered station Bhellupura. Tenders for these have been called for and on receipt of these sanction will be obtained to put this work in hand. One or two large raised reservoirs in the city are also badly wanted, these would do a great deal to insure better pressures during the hours of maximum demand. Funds for one such reservoir have been given by Government and preparation of an estimate is in hand but the question of a suitable site has still to be settled.

One question raised by the Benares Board which is under consideration is the necessity for providing roughing filters so as to increase and improve their supply of filtered water. No final decision has yet been come to as regards the type of filters to be adopted. An estimate is under preparation for raising the settling tanks so as to increase their storage capacity and insure better settlement of the crude water before it enters the filters.

The distribution system needs to be carefully examined as there is often a shortage of water in some portions of the town, while other parts are receiving an excess supply. I have had no officer to spare for this work up to the present but hope to be able to take up this question soon.

The Chairman of the Municipal Board is anxious for me to send him a trained Engineer to look through the Benares drainage scheme and furnish him with a detailed report on it. Up to the present, for want of staff, I have been unable to comply with this request. I sent a trained subordinate to help the Municipal Engineer to get together some details for this report, but this was all I could manage. The work is important and when the Sanitary staff is strengthened it may be possible to take up and deal with this question also.

Cawnpore water works.—The filtered water works station at Benajhabar has been well looked after and the quality of the water throughout the year has been good. There was a considerable amount of slip in the engines at the unfiltered station at Bhaironghat amounting on an average to about 25 per cent. After the rains it was found that the main channel of the river had shifted more than a mile from the pumping station and great difficulty was experienced in getting sufficient water for the pumps. It was only by employing a very large number of men to keep a channel open between the pumping station and the river at a cost of Rs. 28,744 that water was obtained. This expenditure is likely to be repeated for some years unless the river changes its course and comes back to its former channel near the pumping station. A small experimental tube well is being sunk to see how far it is practicable to draw water from the sub-soil strata near the river. This experiment is not yet complete.

The work in connection with the increased supply of filtered water for Cawnpore is now well advanced. The expenditure during the year was Rs. 3,21,375.

The water works improvement scheme sanctioned by the Sanitary Board in July 1911 provided for—

(*a*) increased pumping plant at Bhaironghat and Benajhabar pumping stations;

(*b*) extension of the filtration plant ;

(*c*) new boiler and engine house and other buildings.

New delivery main from the filtered water station to the town and the construction of a new balancing tank at the end of the new main.

(*a*) The additions to the pumping plant consist of one 100 H. P. vertical triple expansion surface condensing pumping engine at the unfiltered water station. One 143 H.P. horizontal high duty Worthington Duplex pumping engine at the filtered water station, Two Babcock and Wilcox boilers, two overhead travelling cranes and all necessary suction pipes, valves and accessories. The boiler and engine at the unfiltered water station have been erected and are nearly complete. Those at the filtered water station are in course of erection.

(*b*) The extension of the filtration plant consists of multiple filters on the Puech Chabal system and comprises four sets of degrossisseurs or roughing filters arranged in three stages and eight prefilters of coarse sand. The total area occupied by the filters is about 256′ × 230′ of which 156′ × 230′ is taken up by the prefilters and the remainder by the degrossisseurs and distributing channel.

A small oil engine and a Roots blower are provided to supply air under pressure for cleaning the degrossisseurs.

The degrossisseurs and prefilters are designed to enable the final filters to be worked at a higher rate of filtration than was the case when they had to deal with settling tank water. The construction of the plant has been completed and it is now in operation and under trial.

(*c*) The new boiler and engine houses and other buildings at Bhaironghat are complete so far as the main structure is concerned, the following yet remain to be done, the engine room floor, porch, connecting passage between the old and new engine houses and a Venturi meter chamber. The new boiler house and other building works at Benajhabar are in progress.

The new 20″ delivery main from Benajhabar to the town has been laid with the exception of railway crossings and the special pipe and valve work at the pumping station and water tower. The water tower at Halsey Road is in course of construction. The steel tank is in position and will be tested by filling it with water before the masonry tower is proceeded with. The proposal to put in a District waste-meter system has been approved and the estimate sanctioned and a grant made by Government. This work will be taken up shortly.

Cawnpore Drainage Works.—A complete scheme for sewering Cawnpore has been asked for and surveys are being made and levels taken in connection with this. In addition to this a scheme for the extension of Cawnpore city is under consideration and surveys are being made of suitable areas for this purpose.

The question of removing the main sewage outfall from its present position below Cantonments has also to be considered and will need to be carefully examined this winter. Little can be done till the drainage survey and levels now under preparation are complete.

Lucknow water works.—The filtered water works station at Aishbagh was maintained in good and efficient order throughout the year, but the state of the unfiltered station at Gau Ghat was not altogether satisfactory and there was a considerable amount of slip in the unfiltered engines amounting on an average to 21·6 per cent. The quality of the filtered water throughout the year was good.

In order to put the Lucknow water supply in a satisfactory state a third pumping engine must be put in at Aishbagh to act as a stand by. As it is only by working the two filtered water engines together during the hours of maximum demand that sufficient pressure is obtained. The absence of balancing tanks adds to the difficulty of keeping up the pressure, but even with the limited balancing tank capacity which it is proposed to provide, a third engine at Aishbagh will be needed.

The new high duty inverted fly wheel engine with the new water-tube boiler and economiser at Gau Ghat which were being erected by James Simpson and Co., were completed last February and the trials of the engine were made in my presence ; the engine worked very well and was taken over by the municipality. The Government made a grant of Rs. 97,000 for this work. The Municipal

Board have sent in proposals to erect a second engine of this type at Gau Ghat but no case has been made out to justify this expenditure.

If the existing engines at Gau Ghat can be utilized at Aishbagh a new engine might be put in at Gau Ghat. I fancy this will be the most satisfactory solution of the question. A new Venturi meter is being erected at Aishbagh but the Venturi chamber is badly designed and the Municipal Board would do well to refer such plans to the Sanitary Engineer or to the Municipal Supervising Engineer before sanctioning them.

In order to get better and more uniform results with the filters, it is necessary to raise the settling tanks and increase their storage capacity and work them as continuous settlement tanks. There are seven filters each 200′ × 100′ and they are ample for present requirements. The rate of filtration need never go higher than 30 gallons per square foot if proper arrangements are made for working them. The provision of automatic regulators to the filters would be an advantage. I obtained quotations for these, but under the Chief Engineer's instructions it is intended to experiment first with a newly invented module regulator on one filter, this will be much cheaper if it proves to be satisfactory. There is a question of putting in some experimental roughing filters at one of the stations of the United Provinces but it has not yet been settled whether these will be put in at Lucknow or elsewhere.

The balancing tanks for which money was allotted last year have not yet been erected but proposals for erecting them are now before the Chief Engineer. A second rising main from the unfiltered station will probably be needed before very long but it need not be put in before the maximum demand rises above 4¼ million gallons; it is only 3,800,000 gallons at present.

The want of pressure in parts of the trans-Gumti area will probably necessitate relaying some of the pipe lines on that side. This question is being enquired into.

Lucknow drainage works.—No large works were carried out during the year. A branch sewer was laid between the Carlton Hotel and the intercepting sewer at Hazratganj at the expense of the proprietors of the hotel. Government House was also connected with the intercepting sewer. A project was also prepared by the Sanitary Engineer and approved by the Municipal Board for connecting the Oudh and Rohilkhand Railway station at Charbagh with the municipal system and as the Railway have agreed to pay for the cost of this connection, this should be taken up soon.

The question of doing away with the two sullage farms, one at Gullalahar, and the one near Wingfield Park, and pumping the sullage to a new farm across the river, is under consideration. Some surveys have been prepared for this, and rough proposals made. The question is to be considered at Lucknow in August.

Among the town improvement schemes carried out by the municipality, the construction of a number of model houses for the poor, built on the Sanitary Engineer's type plans at a cost of Rs. 20,900 might be noticed. A good deal of very useful work has also been done by the Lucknow Improvement Trust in connection with the new sanitary road under construction and the laying out of the areas in its vicinity. They are to be congratulated on the results achieved and the great improvements that have been made in the areas dealt with.

Meerut.—The water works station at Bhola, Meerut, has been well looked after and the quality of the water supply throughout the year has been excellent. The demand for filtered water at Meerut is increasing rapidly and the plant will soon be working to its full capacity. In 1909-10 the total supply for the year was 300 million gallons and last year (1912-13) the supply rose to 419 million gallons. The pumps are worked by water power, so the running expenses are small and they could easily work 24 hours if necessary. There are two standpost reservoirs each containing 100,000 gallons. It is proposed to increase the storage to permit of continuous pumping being done with increased storage during the night.

Meerut drainage scheme.—Nothing further has yet been decided about carrying out the drainage scheme. The municipality, however, were anxious to get their storm water outfalls, which were giving considerable trouble, seen to. These have been surveyed and proposals for improving them are nearly ready. They have also asked for estimates for arching over the large open drain between the Kamboh and Bhaghat gates with a view of converting this into a main road, this estimate will soon be ready. A third proposal which they want worked out is for arching over the deep drains in the vicinity of the mule corps lines with the object of making new roads here. This project also is nearly ready. When these schemes are sent in the municipality may be able to come to some decision as to what they want done.

Mussooree.—The water supply at Mussooree throughout the year was well maintained. There was only one day's interruption in February due to a breakdown in the high tension lines caused by trees falling across them during a snow storm. Some trouble was, however experienced with the rope gearing and crank shafts of the pumps. Driving ropes frequently gave way and on two occasions the crank shaft of No. 1 set broke at the junction of the crank, while on another occasion the crank shaft of No. 2 set developed a serious flaw at the same place. Proposals for remedying these defects and altering the gearing and system of driving these pumps are under preparation and funds for this work have been given by Government. Receipts from the sale of water rose from Rs. 7,524 to Rs. 8,987 during the year.

A new motor pump for the John Mackinon Spring will shortly be erected and it is proposed to put in a second motor pump here with an alternative method of driving by oil engines to guard against a breakdown in the electric supply and enable the antiquated steam plant to be got rid off. This spring yields a minimum supply of 40 gallons a minute of fairly soft water and by and by utilising this supply the Podina Spring, the hardest of the three Murray Springs, can be cut out of the supply, which will greatly improve the quality of the Mussooree water supply.

Mussooree electric works.—The entire reconstruction of the distributing system for the high and low tension lines had to be undertaken during the year. The old sal balli posts had decayed and become dangerous, causing numerous breakdowns and they had to be replaced by galvanized posts. The entire cost of this work is close on one lakh of rupees of which Rs. 35,000 will be spent on the high tension line. The cost was met from a municipal loan.

Landour.—Work was started on the Landour Bazar improvement and sanitation scheme early in October last year and with the exception of the land on the Castle Hill estate all property required for the road was acquired and taken possession of. Up to the end of the year about one-third of the road was done and all the pipes, sewers and specials required for sewering had been brought to this site.

The laying of sullage pipes in the Kulri Hill area which is also included in the scheme is nearly complete. The work is being done by the municipality under the supervision of the Sanitary Engineer. Mr. W. H. Clifford is in direct charge. The expenditure during the year was Rs. 40,485 against an estimate for Rs. 2,25,000.

Naini Tal.—The following works for improving the quantity of the Naini Tal water supply have been carried out. The slope nearest the springs at the Naini Tal water supply station have been wired in. The drain at the back of the engine house has been cemented over. The work of raising the bottom of the suction well and cement pointing the bottom and sides of the Baranadi to prevent contamination has been taken in hand.

The areas round Forest Spring I and the China high level springs have been cleared and wired in and the spring-houses cleaned. A new pipe line has been made to Forest Spring II. The Pilgrim Springs which were liable to contamination have been cut out of the system and they are now used solely for flushing. The lake engines have been thoroughly repaired and put in order and the connection *to Pilgrim reservoir restored*, they will always *be useful for providing water for* flushing and road watering purposes. The engine house and machinery has been well looked after and many improvements have been made and there has also been a considerable saving effected in the cost of fuel. The only drawback is the omission to put in mechanical stokers for which funds were given by the Sanitary Board last year. Apart from any economy in fuel, if these stokers only reduce the smoke nuisance they would be worth putting in and I trust the question will be revived. An estimate for Rs. 34,032 for improving the watersupply at Naini Tal has been sanctioned. Funds have been given by Government for this work. It should be put in hand shortly.

Moradabad.—This drainage scheme has been completed but the completion report has to be made out and the accounts finally settled and passed. Some minor defects in the scheme as carried out remain to be put right and Government have given a grant for this purpose. The municipal board have asked that a scheme for a more complete and elaborate system of drain flushing should be prepared so that it might ultimately be expanded into a system for water supply. The Sanitary Board have asked for a preliminary report about this and the question is under investigation. The Moradabad municipality are not in a position to finance a scheme of any magnitude and it is doubtful if a practicable scheme can be prepared for the small amount which is likely to be available.

Mirzapur water works.—This work which is being carried out under Mr. Amoore, Assistant Engineer, Public Works department, as a special Public Works sub-division. The whole of the work is practically completed with the exception of a large collecting reservoir at Tanda. It was hoped that this reservoir would also be finished and that the work would be opened after this year's rains but there was considerable difficulty in getting sufficient labour for the embankment earthwork and the damage done by a heavy fall of rain in June caused these hopes to be abandoned. This was a great pity as it practically means that the supply of water has been delayed for a whole year. The expenditure for the year was Rs. 3,58,686 and the total expenditure to date is Rs. 4,11,566 against an estimate of Rs. 5,98,500.

Fyzabad and Ajodhya.—Work on the Fatehganj Nala portion of the drainage scheme of Fyzabad is nearing completion. The total of the estimate is Rs. 1,60,077 and the expenditure has been Rs. 84,855. The Board now contemplate taking up a combined scheme for water supply and flushing and the engines are to be designed so as to be capable of being utilised at night for an electric light installation. A scheme on these lines is being worked out, and with a view to reduce the cost as far as possible an attempt is being made to get a water supply from tube wells. If this is possible at Fyzabad. The *alternative scheme of* pumping from the Gogra is beyond the capacity of the Board to finance. As the Fyzabad and Ajodhya are a combined municipality this water supply scheme is to include Ajodhya. A separate drainage scheme is also needed for Ajodhya.

Ajodhya derives its importance from the fact that it is a great pilgrim centre and it is just possible that funds may be forthcoming for the Ajodhya portion of this work from a special grant even if Fyzabad is unable to find money for its own requirements.

Aligarh.—The drainage scheme for Aligarh has been sanctioned for Rs. 6,30,440 and Government has given a grant of one lakh towards this work; about 1½ lakhs are available from municipal funds. Tenders have been called for and it is proposed to start on the main drains, the storm water drains and the sullage pumping station. Work should be commenced this cold weather. A flushing scheme from tube wells has to be worked out and it has to be designed so that it may be worked in with a scheme for a complete water supply which may come later.

Saharanpur.—An anti-malarial scheme for destroying the breeding ground of anopheles mosquitoes in and around Saharanpur is in hand, the work is being done by the Irrigation department. One of the proposals made for the anti-malarial project was to divert the Pandohi river from its present course through the heart of the city to a new course outside the city area. No definite conclusion has yet been arrived at as to whether this should be done or not. As this proposal and the drainage scheme proposals are somewhat involved, it is necessary to decide definitely regarding the Pandohi alignment before the drainage scheme proposals can be definitely formulated. Personally I am in favour of the diversion if it is carried out from the point where the Pandohi and Nala meet. The estimate for the drainage scheme comes to Rs. 4,35,110.

Killcana

Another scheme for Saharanpur which is under investigation is for a combined water supply, electric lighting, and flushing scheme. The water will be drawn from tube wells and the machinery for pumping and lighting are to be worked by hydraulic power from the canal falls which are less than three miles away. The scheme is a very attractive one and once it is constructed the maintenance charges will be small. I had intended employing Mr. Hoey, Assistant Engineer, on this scheme last October, but he has not come to me yet and I have not had a suitable man for the work. I hope to push on with it this year and preliminary data are being collected.

Bahraich.—A drainage scheme amounting to Rs. 3,56,847 has been sanctioned and will be put in hand shortly. An Assistant Engineer, has been posted to Bahraich to look after the work under the District Engineer, Mr. Northcote. Tenders have been called for and are under consideration, funds are available.

Rikhikesh.—A drainage scheme estimate amounting to Rs. 1,01,571 has been sanctioned and work on this has been started. An Assistant is in direct charge working under Mr. Jones, District Engineer of Dehra Dun.

Jaunpur.—Revised scheme No. 3 has been prepared and sanctioned for Rs. 54,000 and work must be started this winter. Funds are available from a Sanitary Board's grant. A water supply and flushing scheme is required and is being worked out.

Shahganj.—This is in the Jaunpur district. A drainage scheme estimate has been sanctioned for Rs. 69,848. Funds for doing the main drains and the storm water drains are available from a Sanitary Board's grant and work should be started this winter.

Ballia.—A scheme for Rs. 1,99,156 was prepared but it was not approved and a modified scheme for Rs. 80,000 was asked for, this is ready. About Rs. 50,000 is available from the Sanitary Board's grant and it is possible the work may have to be taken up soon.

Almora.—A drainage scheme amounting to Rs. 27,948 is in hand. It is being done by the Municipality under a special Overseer and is supervised by the District Engineer. Expenditure to end of year was Rs. 18,346.

Kaimganj.—This work is being done by Municipal Agency and has been inspected by one of my Assistants. Expenditure was Rs. 8,835.

Kanauj.—This work has been done by Municipal Agency and has been inspected by one of my Assistants. Total expenditure for the year was Rs. 3,344.

Garhmuktesar.—A scheme for Rs. 8,752 has been sanctioned and funds allotted. The work will be done by the Public Works department.

Nagina.—An anti-malarial scheme has been sanctioned and is being carried out by the Irrigation department. Two small schemes for improving the drainage amounting together to Rs. 10,623 were sanctioned and funds given. The work will be done by the Public Works department.

Dhampur.—A drainage scheme for Dhampur amounting to Rs. 82,821 has been sanctioned and funds have been given by the Sanitary Board. This work will have to be taken up shortly by the Public Works department.

Bareilly.—A sum of Rs. 50,000 has been allotted to Bareilly for drainage works, but there is no scheme prepared for this place. The preparation of a complete scheme should be taken up.

Budaun.—A sum of Rs. 30,000 has been allotted for further drainage works at Budaun. There is a sanctioned estimate and the work should be started this winter. There is a sanctioned estimate for Rs. 3,10,876 and Rs. 93,255 has been spent already.

Dehra Dun.—The water works scheme finished a year ago is working satisfactorily. Plans and estimates have been drawn out for extending the drainage system at a cost of half a lakh.

Hapur and Khurja Drainage works.—A special public works sub-division was formed with Mr. Miles, Temporary Assistant Engineer in charge, for carrying out the above works. The total value of the work done during the year including establishment charges was Rs, 89,540 at Hapur and Rs. 46,126 at Khurja against sanctioned estimate for Rs. 208,893 and Rs. 1,37,840 respectively. Government made a grant of Rs. 1,00,000 to Hapur for the work. These works will be completed this year. Schemes for flushing from tube wells are being got out for both places and are nearly ready, but experiments with trial bores for wells are needed.

Jhansi.—The scheme for a supplementary water supply which was in hand under supervision of the Irrigation department has now been completed, but as it has only just been brought into use, no statistics of its working are available. Work on the Jhansi drainage scheme has not been started. The Sanitary Engineer was asked to go down and advise as to expenditure of funds, but so far I regret to say I have not had time to visit Jhansi and go into this question.

Kosi.—An anti-malarial scheme has been sanctioned for Kosi and is under construction by the Irrigation department. This will improve the main outfall drain for the disposal of storm water and sullage in Kosi as well.

Muttra.—A drainage scheme amounting to Rs. 2,99,368 has been prepared and sanctioned for Muttra. Funds to the extent of two lakhs have been given by Government and work will be started shortly. A water supply scheme for

Muttra is also under preparation. It is intended to obtain the water required from tube wells.

The distribution scheme has been worked out and the borings are in hand to decide exactly where the tube wells are to be located. This work should be taken up this cold weather also.

Hardwar.—A scheme for a supply of water to the Hardwar Union consisting of the municipalities of Hardwar, Mayapur, Jawalapur and Khankal at a rate of 20 gallons per head per day is under preparation. A scheme for electric lighting is also being prepared. The power for these two works will be taken from the canal works at the Bahadurabad falls.

A complete drainage scheme for Hardwar is also required and possibly a town extension scheme as well. Some work on the preparation of the water supply scheme has been done but this must be taken up and completed this cold weather.

Moradabad, Fyzabad, Khurja, Hapur, Jaunpur, Chandausi, Hathras, Muzaffarnagar, Ghaziabad, Budaun.

The places mentioned in the margin with completed or partially completed drainage works are in need of flushing schemes. These are being investigated. They are being drawn out to work in with future schemes for water supply and so calculations have to be made for the entire system of water supply distribution at each place. Funds are either available or promised in most of these cases.

The following places with drainage schemes sanctioned for which funds are available and in which work will be started shortly require flushing schemes worked out on similar lines. In these cases also the work may be considered urgent :—

Aligarh, Bahraich, Saharanpur, Shahganj, Brindaban, Ballia and Etawah.

Besides the works enumerated there were some petty schemes referred to by Municipal Boards and Act XX Towns which were examined and criticised. A few standard plans for meat and vegetable markets, latrines and hide curing godowns were made out.

The projects in hand and under investigation at present amount roughly in value to a total of 73 lakhs. Those urgently needed but not yet taken up come to 27 lakhs more. There is a further list of less urgent projects amounting to over 50 lakhs to be taken up when the more urgent ones now in hand are disposed of. This list is being constantly increased by the addition of new schemes asked for. The details of these will be found in the revised programme of sanitary works now under preparation and issued separately.

DATED ALLAHABAD :
The 28th July 1913.

C. H. WEST,
Sanitary Engineer to Government,
United Provinces.

APPENDICES.

APPENDIX

UNITED PROVINCES

Statement of operations

Particulars.	Agra.	Allahabad.	Cawnpore.
Population.			
By Census of 1911 in municipality ...	163,935	159,701	173,973
Ditto cantonments ...	21,514	11,996	21,517
Number of inhabitants drawing their supply from mains.	185,449	171,697	173,973
Consumption of water.			
During the year including cantonments, gallons	1,180,747,500	851,797,331	1,471,787,227
Daily average including cantonments ,,	3,234,925	2,333,691	4,032,293
Maximum daily average in any one month ,,	3,841,635	2,766,426	4,746,426
Water used for irrigation and manufacturing purposes, gallons	228,020,583	185,658,749	338,240,121
Water used for domestic purposes, ,,	952,726,917	666,138,582	1,133,547,106
Water consumed per capita ,,	14·07	10·62	17·85
Daily average for cantonments alone ,,	210,776	151,390	...
Number of house connections during 1912-13 ...	98	235	297
Number of metered connections	153	340	75
Annual receipts and charges.			
Maintenance charges ... ... Rs.	79,605	1,00,915	1,34,011
Cost per 1,000 gallons consumed	1·07 annas	1·89 annas	1·56 annas
Cost per 1,000 gallons per 100 feet lift ...	·557 ,,	·984 ,,	1·06 ,,
Cost of water per 1,000 gallons including interest and sinking fund charges.	2·45 ,,	3·67 ,,	2·38 ,,
Lift of pump.			
From river to settling tanks	45′	94′	91·61′
From filtered water pumps to town distribution	147′	76′	56·02′
Total lift ...	192′	170′	147·63′
Income from water works.			
Water rate recovered during the year Rs.	82,670	97,078	...
Sale of water and other receipts ,,	33,329	43,458	93,618
Total income ,,	1,15,999	1,40,536	93,618

No. I.

WATER WORKS.

during the year 1912-13.

Benares.	Lucknow.	Meerut.	Mussooree.	Naini Tal.
199,868	240,016	76,351	11,985	16,788
3,936	19,782	39,876	2,511	1,239
199,868	259,798	116,227	Approx. 11,000	*18,027
...				
1,707,202,732	990,815,637	419,264,191	31,042,012	29,682,848
4,677,267	2,714,500	1,148,669	85,047	81,323
7,840,528	3,870,000	1,795,716	116,877	156,339
22,533,000	220,980,000	12,188,400	Nil ...	352,720
1,684,669,732	769,835,637	407,075,791	31,042,012	29,330,128
22·64	8·11	9·60	7·73	5·67
8,692	303,000	341,854	1,077	4,412
511	609	585	155	192
2	310	36	156	192
1,03,834	85,807	26,386	24,396	43,792
·97 annas	1·38 annas	1·01 annas	12·5 annas	1·47
·66 „	·679 „	·64 „	·74 „	·18
1·92 „	1·318 „	2·71 „	Rs. 1·84	2·25
71·40′	128′	15·16′	Nil ...	Tonnochy 1,160′
73·80′	76·5′	141·85′	... 1,700′	Ayarpatta 1,093′ *Pilgrim* 240′
145·20′	204·5′	157·01′	1,700′	2,493′
124,884	35,335	...	Nil ...	28,073
92,091	90,838	42,014	9,654	15,228
1,34,093	1,26,173	42,014	9,654	43,301

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* Summer residential population; cold weather population being 10,272.

APPENDIX No. II.

Annual maintenance accounts of water works in the United Provinces during the year 1912-13.

Nature of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut	Mussooree.	Naini Tal.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. *Establishment—*								
(*a*) Permanent establishment.	21,239	23,328	28,963	29,686	23,586	10,665	15,062	10,202
(*b*) Office contingencies	1,783	621	1,123	520	695	5,737		269
(*c*) Rents	...	1,540	600	...	660	360	...	250
2. *Pumping—*								
(*a*) Coal	36,058	30,250	30,198	33,439	41,156	5	...	17,473
(*b*) Oil and waste ...	3,079	2,295	4,490	2,396	1,142	481	473	1,233
(*c*) Other stores ...	3,194	3,390	4,508	7,043	2,049	3,091	282	3,091
3. *Intake—*								
(*a*) Training river ...	1,018	...	7	28,744	...	...	...	...
(*b*) Clearing channels and wells.	2,369	82	195	...	...	50	...	...
4. *Settling tanks and filters—*								
(*a*) Clearing settling tanks.	825	373	2,385	...	2,485	50	...	...
(*b*) Clearing and renewing filter beds.	1,588	4,090	2,837	5,362	20	3,043	...	*186
(*c*) Purchase of sand,	...	5,172	2,995	4,969	4,406	...	...	...
(*d*) Alumino ferric ...	...	...	9,984	5,148	...	...	...	...
5. *Distribution—*								
(*a*) Pipes and fittings ...	388	12,500	3,030	6,869	2,851	559	211	4,102
(*b*) Meters ...	3,061	2,653	...	2,545	5,292	...	165	368
6. *Repairs—*								
(*a*) To tanks ...	234	...	201	...	...	153	408	244
(*b*) To buildings and grounds.	1,960	412	1,568	1,307	518	841	679	1,309
(*c*) To machinery ...	2,691	13,520	6,980	5,817	600	1,071	7,037	3,620 205
(*d*) To rising main ...	...	...	1,976	...	...	...	...	...
7. *Water analysis* ...	118	689	1,794	166	347	280	179	1,240
Total ...	79,605	1,00,915	1,03,834	1,34,011	85,807	26,386	24,496	43,792

* Repairing filter house.

APPENDIX No. III.

Statement showing the initial capital cost of subsequent extensions and improvements incurred on water works in the United Provinces up to the end of the 31st March 1913.

Water works stations.	Initial capital cost.	Cost of subsequent extensions.	Cost of extentions during the year 1912-13.	Total.
	Rs.	Rs.	Rs.	Rs.
Agra	11,70,761	6,35,390	33,626	18,39,777
Allahabad	16,24,061	1,88,861	94,925	19,07,847
Benares	25,61,881	4,85,621	16,041	30,63,543
Cawnpore	14,44,570	3,49,352	3,21,375	21,15,297
Lucknow	15,15,736	3,78,839	71,943	19,66,518
Meerut	7,51,710	35,536	1,587	7,88,833
Mussooree	1,14,014	12,856	5,140	1,32,010
Naini Tal	2,47,000	3,34,624	5,715	5,87,339

APPENDIX IV.

Statement showing rate of filtration and results of water works of the United Provinces, during the year 1912-13.

Municipalities.	Rate of filtration per square foot in 24 hours.			Chemical analysis.			Bacteriological analysis.	
	Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.
Agra	38	24	31	1	1	2	53	5
Allahabad ...	56	17	34	...	...	...	232	76
Benares ...	50	23	31	...	...	...	366	20
Cawnpore ...	38	37	37	1	...	1	56	1
Lucknow ...	36	24	29	3	...	3	344	26
Meerut ...	39	11	24	2	...	2	187	3
Mussooree ...	...	...	...	...	...	...	...	...
Naini Tal ...	...	...	...	6	...	6	...	...

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising

Particulars.	Agra.	Allahabad.	Benares.
1. Consumption of water per capita in gallons.	14·07	10·62	22·64
2. Number of inhabitants drawing their supply of water from the mains.	185,449	171,697	199,868
3. Water used for irrigating and manufacturing purposes.	228,020,583	185,053,749	22,533,000
4. Power of pumps per hour in gallons at river.	2 Horizontal pumps each— Designed for 84,000 Maximum ... 96,000 Average ... 78,000 1 Worthington low duty pump. Designed for 120,000 Maximum ... 132,000 Average ... 102,000	Designed for 126,000 Maximum ... 154,961 Average ... 114,862	Designed for 252,000 Maximum ... 189,140 Average ... 172,383 1 Worthington high Duty pumping engine designed for gallons ... 500,000
5. Horse power each engine is designed for.	2 Horizontal pumps of 28 horse power each. 1 Worthington low duty engine of 31 horse power.	2 Engines of 102 horse power each.	2 Horizontal engines 141 horse power each. 1 Worthington high duty engine.
6. Power of pumps per hour in gallons at filter.	2 Beam engines each Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1 High duty Worthington. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	Designed for 223,300 Maximum ... 265,000 Average ... 188,453	Designed for 462,000 Maximum ... 455,809 Average ... 375,150
7. Horse power each engine is designed for.	1 High duty Worthington of 130 horse power. 2 Beam engines of 100 horse power each.	2 Engines of 135 horse power each.	4 Beam engines of 114 horse power each.
8. Number of rising mains ...	2	1	2
9. Length of rising mains ...	2·5 and 1·75 miles respectively.	1·9 miles	·82 and ·94 miles respectively, i. e. Old rising main 4,727′ New „ „ 4,100′
10. Size of rising mains ...	28″ and 18″	20″	Both 24″
11. Number of settling tanks ...	5	3	3
12. Size of settling tanks ...	Each 266′ × 151′ Capacity of each 2,200,000 gallons.	Each 280′ × 180′ Capacity of nos. 1 and 3=2,733,665 gallons, and that of no. 2 =2,819,243 gallons.	(288′ + 20′)×(238′ + 20′) × 15′. Capacity of nos. 1 and 3=6,436,120 gallons, and that of no. 2. =6,508,927 gallons.
13. Number of filters... ...	7	6	8
14. Size of filters	Each 200′ × 10′	200′ × 100′	200′ × 100′ × 6′—4½″
15. Number of C. W. reservoirs ...	3	2	2
16. Size of C. W. reservoirs ...	103′ × 105′ × 10′	Each 160′×103·3′×12′ Capacity ... 1,168,700	(178′—4″) × (148′—4″) × (16′—1″). Capacity 1,879,631 gallons.
17. Number of service reservoirs or standpipes.	43 four-tap standposts each ¾″ size ; 61 two-tap standposts of ¾″ size, 154 one-tap standposts.	One tap standpost 134 Two „ „ 57 Four „ „ 80 Waste not cocks ... 13 Push cocks ... 11 Wall boxes ... 7 Bib cocks ... 6 Generally of ¾″ size.	242 one-tap standposts, 105 two tap standposts, 79 four-tap standposts.

No. V.

mains, &c., in the water works of the United Provinces for 1912-13.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
17·85	8·11	9·60	7·73	5·67
178,973	259,798	116,227	Average per year ... *11,000	*16,027
338,240.121	220,980,000	12,198,400	...	352,720
Two pumps each—Designed for 187,500 gallons.	Designed for 187,500	Designed for 72,000	Designed for 10,800	Lake station 11,355
Maximum 187,500 gallons.	Maximum 188,237	Maximum 61,965	Average 10,920	Barandi Springs } 13,326
Average 165,000 gallons.	Average 178,517	Average 37,087	Maximum Not known.	
2 Engines of 86 horse power each.	3 Engines of 130 horse power each.	1 Engine of 26 horse power. 2 Turbines each of 90 horse power.	Each motor pump designed for 150 horse power.	31 horse power.
Two pumps each—	Designed for 180,000	Designed for 66,000	...	
Designed for 187,500	Maximum 25 per cent. over.	Maximum 50,611	...	
Maximum 187,500	Average 175,000	Average 30,327	...	
Average 174,375				
2 Engines of 80 horse power each.	2 Engines of 110 horse power each.	...	...	
2	1	1	1	4
1·32 miles	3·5 miles	15″ main=33,292′ 13″ main= 8,550′	1·18 miles	Ayarpatta ·93 miles. Tonnochy ·66 ,, Pilgrim ·34 ,, Lake ·19 mile.
Each 20″ dia.	20″	13″ and 15″	5″	4″ 3½″, 3″, 4″
3	3	3	...	...
Each 355′ × 275′ capacity 3 million gallons.	250′ × 200′	100′ × 60′ × 11′	...	...
7	7	4	...	1 Jewel filter 12′ dia.
200′ × 100′	200′ × 100′	150′ × 100′	...	...
2	2	1	4	5
Each 135′ × 106′ − 8″ × 12′ deep. Capacity of each 958,300 gallons.	Each 105′ × 107′	48′ × 52½′	2 × 40′ × 25′ × 8′ 1 × 80′ × 21′ × 6′ 1 × 30′ × 20′ × 8′	...
107—4 tap standposts 62—2 ditto 37—1 ditto 50′—6″ high × 38′ dia.	170 one-tap standposts; 227 two-tap standposts.	86 one-tap standposts of ⅝″, 90 two-tap standposts of ¾″. 3 wall fountains 4 taps of ½″.	12 iron service tanks 82 stand-pipes of 2 taps.	64 service tanks, 27 standposts.

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* Summer population.

APPENDIX

Details of pumps, filters, tanks, reservoirs, rising

Particulars.	Agra.	Allahabad.	Benares.
18. Size of service reservoir ... 2 Circular balancing tanks ...	66′ dia. × 11′–4″ deep 20′ dia. × 50′ deep each.	60′ dia. × 11′ deep ...	60′ dia. × 15′ deep Capacity 260,000 gallons.
19. Lift of pumps from river to settling tanks.	45 feet head	94′	71·40
20. Lift of pumps from filter water pump to town distribution.	147 „	76′	73·80
21. Cost of supplying water per 1,000 gallons.	1·07 annas	1·89 annas	·97 annas
22. Cost of supplying water per 100′ lift.	·557 „	·984 „	·66 „

V.

mains, &c., in the water works of the United Provinces, for 1912-13—(concluded).

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
Holds 320,000 gallons	66′×12′	2—Each 25′ + 34′	2×40′×25′×8′ 1×80′×24′×6′ 1×30′×20′×8′	28 round service tanks 3′×3′, 28 round service tanks 2′—8″ × 3′, 8 square tanks 6′×8′×4′.
91·61′	128′	15·16′	11·5′(*a*)	From collecting reservior to Tonnochy ... 1,160′ Ayarpatta ... 1,093′ Pilgrim ... 240′
56·02′	76·5′	141·85′	17 00′(*b*)	...
1·56 annas	1·38 annas	1·01 annas	12·5 annas	Re. 1·47
1·06 „	·679 „	·64 „	·74 „	„ ·18

(*a*) Suction lift from collecting reservoir to pump.

(*b*) Lift from pump to town distribution.

APPENDIX VI.

Detailed statement showing the expenditure incurred on original works of a sanitary nature, executed under the supervision of Sanitary Engineer during the year 1912-13.

Name of municipality.	Expenditure incurred on—			Total expenditure.
	Water works.	Drainage works.	Other works.	
	Rs.	Rs.	Rs.	Rs.
Agra	31,381	5,854	...	37,235
Allahabad	94,925	42,423	...	127,380
Benares	16,041	90,809	10,191	101,000
Cawnpore	3,21,375	...	...	321,375
Lucknow	71,944	14,362	...	59,249
Mussooree	5,140	40,485	...	40,485
Dehra Dun	1,686	1,460	...	3,146
Jhansi	15,146	...	...	15,146
Khurja	...	46,126	...	46,126
Hapur	...	89,513	...	89,513
Fyabad	...	84,855	...	84,855
Almora	...	14,407	...	14,407
Kanauj	...	3,344	...	3,344
Moradabad	...	42,442	...	42,442
Mirzapur	3,42,818	...	...	3,42,818
Kaimganj	...	8,835	...	8,835
Lakhimpur	...	14,053	...	14,053
Meerut	1,587	...	...	1,587
Mussooree	94,723*	...	...	94,723
Naini Tal	5,715	...	...	5,715
Dehra	1,686	...	...	1,686
Jhansi	15,146	...	...	15,146
Total	10,19,313	4,98,968	10,191	15,28,472

* Altering electric high and low tension lines.

APPENDIX VII.

Comparative statement of working expenses of water works schemes in the United Provinces for 1912-13.

No.	Name of water works.	Class of work, gravitation or pumping.	Coal consumption per 1,000 feet, gallons.	Price of coal per ton.	Total lift including friction.	Percentage of charges for—			Average consumption in gallons per head per day throughout the year.	Cost of maintenance per 1,000 gallons.	Cost of maintenance per 1,000 feet, gallons, for pumping scheme.	Cost of maintenance per head of population.	Cost of pumping per 1,000 feet, gallons.	Income per head of population.	Remarks.
						Establishment.	Coal.	Other charges							
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
			Lbs.	Rs. a. p	Feet.					As.	As.	As.	As.	As.	
	Agra	Pumping	·023	14 4 0	192	28·94	45·30	25·76	14·07	1·07	·0056	6·86	·003	10·008	
	Allahabad	Do.	·062	8 0 0	170	25·26	29·98	44·78	10·62	1·89	·01	9·4	·004	13·09	
	Benares	Do.	·032	8 8 6	145·20	29·56	29·16	41·28	22·64	·97	·007	8·3	·003	10·52	
	Cawnpore	Do.	·034	9 10 4	147·63	22·54	24·95	52·51	23·17	1·56	·011	12·3	·0031	8·6	
	Lucknow	Do.	·039	13 8 0	204	29·00	47·96	23·04	8·11	1·38	·007	5·27	·004	7·72	
	Meerut	Do.	Turbine worked by water power.	Nil	157·01	63·30	8·69	28·61	9·60	1·01	·0064	3·63	·0069	5·78	
	Mussooree	Do.	Nil	Nil	1,753	61·7	Nil	38·3	7·73	12·6	...	Rs. 2·32	·0002	14·0	The pumps are driven by electric power and not by steam power.
	Naini Tal	Pumping and gravitation supply.	...	Coal at Rs. 30, wood at Rs. 19.	Tonochy 1,160 ft., Ayarpatta 1,093 ft., Pilgrim 240 ft.	24·45	39·9	36·65	5·67	1·47	·028	As. 2·43	·014	Rs. 2·4	Percentages are in excess owing to previous years bills being met from this year's budget.

III (4)
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SEVENTEENTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES,

FOR THE YEAR ENDING 31st MARCH 1912.

ALLAHABAD:
PRINTED BY F. LUKER, SUPDT., GOVERNMENT PRESS, UNITED PROVINCES.
1912.

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1912.

Seventeenth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending the 31st March 1912.

THE office of Sanitary Engineer to Government was filled by Mr. W. G. Wood from the 1st to 5th April 1911, and from the 16th October to 18th March 1912. From the 5th April to the 16th October, Mr. C. H. West acted as Sanitary Engineer while Mr. W. G. Wood was officiating as Chief Engineer and Secretary to Government, United Provinces, Public Works department. On the 18th of March 1912 Mr. W. G. Wood went on leave and Mr. West took over the work of Sanitary Engineer to Government, United Provinces, in addition to his own work as Under Secretary to Government, United Provinces, Public Works department.

The officers working directly under the Sanitary Engineer were—

Mr. H. E. Parker, Assistant Sanitary Engineer, who was employed from the 1st April to the 26th October 1911, and from the 22nd January to the 26th of March 1912. From 26th October 1911 to the 22nd January 1912, Mr. Parker was on privilege leave and on the 20th March he was transferred.

Mr. A. K. Nandi, Assistant to Sanitary Engineer, was employed throughout the year except for a period from 17th May to the 8th July 1911 when he was on privilege leave. The following officers were engaged on construction of Sanitary Works throughout though not working directly under the Sanitary Engineer.

(1) Mr. A. E. J. Hubbard, Temporary Engineer, employed on drainage works at Moradabad under the Municipality.

(2) Mr. H. J. Amoore, Assistant Engineer, Public Works department, employed under the Executive Engineer, Benares, is carrying out the Mirzapur Water Works.

(3) Mr. R. Miles, Temporary Engineer, employed under the Executive Engineer, Agra, carried out the Firozabad drainage scheme.

A great deal of useful sanitary work was carried out in the larger municipalities through the agency of their Municipal Engineers; this will be detailed when mentioning the work done in the various municipalities. An extension to the water supply arrangements at Jhansi was also carried out through the Executive Engineer, Irrigation Works, Jhansi.

The following large schemes were finally sanctioned during the year:—

	Rs.
(1) Cawnpore water supply scheme... ...	6,67,190
(2) Allahabad drainage scheme	15,71,866
(3) Rikhikesh drainage scheme	1,01,571
(4) Improving Ghaziuddin Hyder canal ...	57,262
(5) New balancing tank, Lucknow	69,850
(6) New unfiltered engine, Gaughat, Lucknow ...	1,00,079
(7) New balancing tank, Agra	42,644
(8) Ghat sewer, Benares	89,239
(9) Improving pakka mahals, Benares ...	13,777
(10) New Orderly Bazar, Benares	68,912

The following projects were prepared and sent to Municipal Boards but were not finally sanctioned during the year:—

	Rs.
(1) Fatehpur drainage scheme	1,55,916
(2) Tilhar	1,11,728
(3) Shahganj	69,848
(4) Ballia	1,99,156
(5) Landaur Bazar Improvement	2,22,564
(6) Proposals for carrying Allahabad sullage pipe across the Jumna river	41,204

The following schemes were under investigation but not completed during the year:—

(1) Muttra drainage scheme.
(2) Brindabun drainage scheme.
(3) Muttra water supply proposals.
(4) Allahabad water supply extension.
(5) Naini Tal water supply improvements.

Survey plans with levels were prepared for Unao, Ahraura and Sitapur and surveys for Farrukhabad and Bisalpur were started. Survey plans of the proposed Allahabad sullage farm and the Agra cantonment drainage were prepared in this office. Enlarged plans of Chandausi and Amroha were also begun.

Surveyors were sent to Gonda and Meerut to get out schemes for rural sanitation.

The eight large water works stations were inspected and the water supplied has been kept up to the usual high standard of purity. There have been two break downs during the year. One at Mussooree where both pumps broke down for three days and one at Allahabad where one engine had to be shut down in the month of March so that certain defects in the fixing of the suction pipes could be put right, this was done in a few days.

In most of the old water works installations in these provinces, the demand for water is now far in excess of the supply and the result is that nearly all these big stations, Agra, Allahabad, Benares, Cawnpore and Lucknow are busy simultaneously with schemes for extensions and improvements. Many of these are taking up new drainage schemes and extensions to existing drainage schemes in addition.

There are also numerous requests for the submission of water supply and drainage schemes for the smaller municipalities. The amount of project work involved is heavy and the superior staff for supervision or preparation of projects is very weak. Mr. Parker has been transferred and has not been replaced, and Mr. Nandi, an assistant, is the only man I have to run the whole of the work. The necessity for strengthening the Sanitary Engineer's staff in this respect has lately been specially represented by me to the Chief Engineer and Secretary to Government, Public Works department, and this matter is, I believe, now under consideration.

This question is an urgent one and as most of the cost of the staff is covered by recoveries of fees, the sanction of the additional staff required should not present great difficulties.

The work carried out by some of the larger municipalities is separately detailed below:—

Agra Water Works.—The demand for water at Agra is now in excess of the supply. Proposals for putting in a new balancing tank near the Thomason Hospital were approved and two 100,000 gallons tanks were purchased from the Delhi Darbar and are in course of erection there. Tenders have also been called for for putting in two new engines of 3,000 gallons a minute capacity each for the unfiltered supply in place of the old and uneconomical three-throw pumps which give 1,500 gallons a minute each. Further proposals for extending the settling tank and filters, and for ensuring a more constant supply of filtered water with better pressure in the outlying parts of the town are also being made. A grant of 2 lakhs has been made by the Local Government to Agra Municipality to help in carrying out these improvements, and it is hoped that in a year's time there will be a considerable improvement in the water supply arrangements for Agra.

Agra Drainage.—A survey has just been started for the purpose of making out a scheme for draining Agra city, the drainage of the city is stated to be badly needed, but it is difficult to see how the work is going to be financed by the board as the cost will be heavy and at least 5 lakhs will be needed to make a start on the scheme.

Allahabad.—In Allahabad the demand for water is now in excess of the supply. A proposal to put in a new unfiltered supply engine and increase the supply of filtered water from 3 to 4 million gallons daily has been approved by the Sanitary Board and Government, and a new engine has been ordered and should be working next hot weather.

As regards the existing engines they are badly in need of overhauling. They are of the old beam engine type and have plenty of life in them yet if properly looked after and it is hoped they will now be put right.

Pages iii and iv of the annual report of the Sanitary Engineer for the year ending 31*st March* 1912.

Substitute these pages for those printed in the above report.

Allahabad Drainage.—The Allahabad drainage scheme, amounting to about 16 lakhs, was sanctioned during the year. Government has given the municipality a substantial grant of 4 lakhs to enable them to start the scheme and work will be put in hand shortly. Detailed proposals for disposing of the sullage on a sullage farm by pumping across the Jumna are now being prepared and will be ready for sanction shortly.

Benares Water Supply.—Both water works stations have been maintained in good and efficient order. The Superintendent is to be congratulated on the very good state of repair in which he keeps his engines.

The new High Duty Triple Expansion Worthington ran her trials on the 9th August 1911, and was then taken over. She has been working most satisfactorily and economically since. The question of increasing the water supply at Benares so as to have a constant service has been under consideration for some time but no decision has been come to as regards the method on which the extensions are to be made.

The board should as a first step towards the introduction of a constant service instal a system of waste-detecting meters so as to judge exactly what the legitimate demand is likely to be when all avoidable waste has been stopped. They will then be in a position to decide what extensions are necessary.

Benares Sewage Works.—A great deal of most useful and satisfactory sanitary work on the construction of sewers has been done by Mr. Bailey, the Municipal Engineer, during the year. Among other works I need only mention the important intercepting sewer along the ghat face; the improvement of the drainage of the pakka mahals for both of which Government gave a grant of Rs. 1,20,000. Over 20,000 l. ft. of drain have been improved in these mahals during the year. The Massanghat sewer which has just been started, the new Nandeswar market and new shops at Bisheshargaaj, the completion of the Alaipura-Bisheshargaaj road and other smaller though very useful branch sewers and drains such as Rodri-Talao storm overflow, Hindu College branch sewer, the Alaipura drain, &c. &c., were constructed. In addition to these a number of water-flushed urinals and latrines have also been put in. This progress is most satisfactory.

Cawnpore Water Works.—The water works station of Benajhabar has on the whole been well looked after. The same, however, cannot be said about the riverside station at Bhaironghat, the slip in these pumps has been something like 30 p. c. and the consumption of coal has been excessive in consequence; a better class of coal might be found most satisfactory.

Very fair progress has been made on the scheme for extending the water works at Cawnpore. The new engines for both the filtered and unfiltered stations have been ordered through Messrs. James Simpson & Co., and should arrive in the cold weather. Messrs. Jessop and Co. are doing the balancing tank, the new rider main and the engine house buildings. The brick-work for the extensions at the Riverside and filtered water stations and on the balancing task is practically completed. Certain extensions of the filtration plant at Cawnpore are in hand. These extensions are being made on the Puech Chabal system of multiple filtration. The maximum daily output of filtered water required is 7 million gallons. This work will be completed this winter when the trials which are to last over a period of twelve months will be started.

Lucknow Water Works.—The following contributions were made by Government towards the cost of the Lucknow water works improvement schemes:—

	Rs.
(1) Contribution for new engine, Gaughat	97,000
(2) Contribution to replace the cracked pump barrel	10,000
(3) Contribution to water supply	25,000
(4) Contribution for balancing tanks	38,000
Total ...	1,70,000

A new Babcock and Willcox boiler has been erected at Gaughat station in the new boiler room, and an extension to the new engine house is complete and awaiting the arrival of the new engine. The coal shed has been removed from its old position and built on a more suitable site. The new pump barrels have been received but have not been fixed yet. An extension has also been made in the distribution, notably one to Butlerganj. The erection of the two new balancing tanks has still to be taken in hand.

Lucknow Drainage Works.—The Husainganj-Ghasiarimandi scheme has been completed during the year. The total expenditure on this amounted to Rs. 2,17,000. The sullage farms at Wingfield Park and Gullalahar worked well. The former yields Rs. 1,106 but the latter produced no income as the cultivators objected to pay anything for the sullage, as the ground irrigated was not municipal property, and no remuneration could be enforced. The Gullalahar farm, owing to the construction of the new Gumti weir, will be liable to be water-logged, and it will be necessary to acquire land across the river in place of this and pump the sullage across. The Wingfield Park farm will probably have to be shifted a little to the north-east.

In addition to the above, good progress was made on the improvement of the Ghaziuddin Hyder canal and on the construction of the new Gumti weir and on work in connection with the new Hewett Road.

Mussooree.—There has been quite a satisfactory improvement in the receipts from the Hydro-Electric Scheme under both heads of lighting and water supply. The receipts from electric current amounted to Rs. 20,279 as compared with Rs. 11,554 in the previous year, and the receipts from water rose to Rs. 8,000 against Rs. 5,621 during the previous year. There was one serious accident during the year when the reducing gear-wheels of both motor pumps broke down at the same time, and in starting of the steam plant one of the boiler tubes burst with fatal results to the attendant in charge. The gearing of the pump has now been improved by cutting out the gear-wheels from boiler plates rivetted together and the rope drive has also been improved by putting in a larger number of small diameter ropes in place of the thicker ropes formerly in use. These changes appear to have done good and the pumps have been working satisfactorily since.

Mr. Menzies, the Electrical Engineer to the Board, retired, and has been succeeded by Mr. Bell. Schemes for improving the Landaur Bazar drainage and draining Kulri, amounting to Rs. 2,25,000, have been prepared and submitted for sanction.

Schemes for putting in an electric pump for Mackinnon Spring and for substituting telegraph poles for the wooden poles on the distribution which have given so much trouble have been sent in for sanction.

Naini Tal.—The engines at the water works station have now been thoroughly overhauled and are now working very well. A proposal for putting in an intermediate level pipe line and pumping the greater part of the water only half way up the hill instead of the high level reservoirs has been approved by the Sanitary Board, and the detailed scheme is now in course of preparation and will be submitted for sanction shortly. This will make a saving in the coal bill. The Jewel filter installed year before last appears to be working well and giving satisfaction.

An estimate for fixing mechanical stokers to the boilers in the engine house has been sanctioned and the Local Government has kindly given the funds and the work will be completed this winter.

Meerut Water Supply.—The quality of water supplied from Meerut water works throughout the year has been excellent and the machinery has been well looked after. An extension of the pipe line has been made to the Nauchandi Fair ground at a cost of Rs. 9,428 for use during the fair times. As regards the Meerut drainage scheme, the board are apparently still undecided as to whether they will have a scheme with sewers or not. It is also doubtful if the proposal to pump the sullage for irrigation purposes appeals to them. Until they come to some decision on these points nothing can be done.

Firozabad.—The drainage work here has been completed and a small saving on the estimate has been utilized in street paving. These improvements should prove a great boon to the people if they will only maintain them in proper order.

Allahabad Drainage.—The Allahabad drainage scheme, amounting to about 16 lakhs, was sanctioned during the year. Government has given the municipality a substantial grant of 4 lakhs to enable them to start the scheme and work will be put in hand shortly. Detailed proposals for disposing of the sullage on a sullage farm by pumping across the Jumna are now being prepared and will be ready for sanction shortly.

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The new High Duty Triple Expansion Worthington ran her trials on the 9th August 1911, and was then taken over. She has been working most satisfactorily and economically since. The question of increasing the water supply at Benares so as to have a constant supply has been under consideration for some time, and has been kept pending the results of the trials with the Peuch Chabal and Paterson filters at Cawnpore and Calcutta. As the Peuch Chabal trials are unlikely to take place these rains, I think, the Board would be well advised to try a system of waste detectormeters, in the meantime to see exactly what expansion, if any, is needed. A system of district waste meters is required to localise and detect wastage and a system of waste-not-taps in places where waste is found to be heavy. The K and L type of cistern tap might be given a trial. If this is taken up now we would be in a better position to state next year how far an increased supply is necessary for a place like Benares where the consumption per capita is already very high.

Benares Sewage Works.—A great deal of most useful and satisfactory Sanitary work on the construction of sewers has been done by Mr. Bailey, the Municipal Engineer, during the year. Among other works I need only mention the important intercepting sewer along the ghat face; the improvement of the drainage of the pakka mahals for both of which Government gave a grant of Rs. 1,20,000. Over 20,000 l. ft. of drain have been improved in these mahals during the year. The Massanghat sewer which has just been started, the new Nandeswar market and new shops at Bisheswarganj, the completion of the Alaipura-Bisheshargani road and other smaller though very useful branch sewers and drains such as Rodri-Talao storm overflow, Hindu College branch sewer, the Aliapura drain, &c., &c., were constructed. In addition to these a number of water-flushed urinals and latrines have also been put in.—This progress is most satisfactory.

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Firozabad.—The drainage work here has been completed and a small saving on the estimate has been utilized in street paving. These improvements should prove a great boon to the people if they will only maintain them in proper order.

Mirzapur.—The progress made on the Mirzapur water works during the year was not as good as we expected but there were difficulties with the contractors and in obtaining labour which threw back the work. It is hoped that the work will be sufficiently advanced to admit of the water supply being started in the rains of 1913.

Jhansi.—Owing to the very late arrival of the rains last year Jhansi got very anxious about its water supply and an emergent scheme costing about one lakh for obtaining a supply from the large irrigation reservoir in the vicinity was put through under the supervision of the Executive Engineer, Irrigation Branch, Jhansi. It is hoped this will be satisfactory for the purpose for which it was intended.

Fyzabad.—The drainage scheme sanctioned for Fyzabad has been hung up for a long time for want of funds. During the year under note the Sanitary Board gave a grant of Rs. 15,000 towards the Fatehganj Nala portion of the work and the municipality provided Rs. 16,000. For the current year Government has given a grant of Rs. 1,12,000 and the municipality Rs. 18,000. So the portion of the scheme now in hand should be completed very soon. The Fyzabad Municipality are also keen on having a water supply scheme, but the scheme as drawn out is more than the municipality can afford to finance. It is possible that if the Irrigation Canal scheme from Ronahi is carried out we may be able to cheapen the water works scheme for Fyzabad somewhat. It will be better therefore to let the matter stand over till the irrigation proposals mature and we can see how they will affect these proposals for Fyzabad.

Moradabad.—The drainage works at Moradabad are completed. The total of the estimate was Rs. 4,81,458. A considerable amount of additional work not originally provided in the estimate was found necessary and carried out while a few unimportant works from the original estimate were omitted. The excess expenditure caused by these alterations above referred to was covered by a further grant of Rs. 50,000 made by the Local Government to balance the accounts. A proper completion report of the work showing exactly the changes made in execution is now needed in order that the expenditure already incurred in excess of sanction may be passed. The Sanitary Engineer's fees and cost of establishment still remain to be adjusted with the municipality.

From the above it will be seen that steady progress has been made both with the preparation of schemes and the carrying out of works. The additional grants now available will enable a good deal of work to be undertaken which otherwise could not have been touched for want of funds for years.

Not many years ago sanitary proposals both for drainage and water supply were often looked on with suspicion or indifference, but judging from the number of schemes now asked for it would appear the people are beginning to regard such works as necessities and there will soon be a popular demand for sanitary measures from most of the municipalities in these provinces.

C. H. WEST,
Sanitary Engineer to Government,
United Provinces.

APPENDICES.

APPENDIX

UNITED PROVINCES

Statement of operations

Particulars.	Agra.	Allahabad.	Benares.
Population.			
By Census of 1911 in Municipality ...	163,935	159,701	199,868
Ditto Cantonments ...	21,514	11,996	3,936
Number of inhabitants drawing their supply from mains.	185,449	171,697	199,868
Consumption of water.			
During the year including Cantonments, gallons	1,145,768,280	923,741,257	1,641,974,660
Daily average including Cantonments "	3,130,514	2,530,797	4,492,959
Maximum daily average in any one month "	3,707,500	3,264,853	7,627,110
Water used for irrigation and manufacturing purposes, gallons	232,189,000	196,557,565	27,897,000
Water used for domestic purposes "	913,579,280	727,183,692	1,614,077,660
Water consumed per capita "	13·46	11·60	21·69
Daily average for Cantonments alone "	222 220	162,107	1,789,750
Number of house connections during 1911-12	1,863	271	553
Number of metered connections	97	339	3
Annual receipts and charges.			
Maintenance charges... ... Rs.	86,064	65,157	83,062
Cost per 1,000 gallons consumed... ...	1·20 annas	1·12 annas	·80 annas
Cost per 1,000 gallons per 100 feet lift ...	·625 "	·660 "	·53 "
Cost of water per 1,000 gallons including interest and sinking fund charges.	2·61 "	3·82 "	1·70 "
Lift of pump.			
From river to settling tanks	45′	94′	79·64′
From filtered water pumps to town distribution.	147′	76′	70·74′
Total lift ...	192′	170′	150·38′
Income from water works.			
Water rate recovered during the year Rs.	79,280	1,01,560	1,23,327
Sale of water and other receipts "	30,322	41,391	12,160
Total income Rs.	109,602	1,42,951	1,35,487

No. 1.

WATER WORKS.

during the year 1911-12.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
157,040	240,016	76,351	*11,985	*16,788
...	19,782	39,457	2,511	1,239
157,040	259,798	115,808	11,000	18,027
1,426,860,274	889,803,645	407,846,816	29,231,930	31,872,522
3,898,525	2,435,000	1,114,335	80,087	87,083
4,715,459	3,440,000	1,671,832	116,391	209,904
360,149,986	150,000,000	9,385,820	Nil.	429,160
1,066,710,288	739,803,645	398,460,996	29,231,930	31,443,362
24·8	9·3	9·40	7·28	5·89
...	339,000	386,437	1,621	3,225
268	469	515	188	187
70	451	36	139	185
105,201	76,447	†24,360	28,962	44,094
1·30 annas	1·37 annas	·96 annas	15·8 annas	1·38
...	·78 "	·64 "	·03 "	·14
1·98 "	1·63 "	2·88 "	2·55	2·105
86·4′	115′	15·16′	Nil.	Tonnochy 1,160′
57·2′	80′	133·98′	1,700′	Ayarpatta 1,093′ Pilgrim 240′
143·6′	195′	149·14′	1,700′	2,493′
...	35,079	Nil.	Nil.	27,505
84,467	84,258	39,256	7,524	11,089
84,467	1,19,337	39,256	7,524	38,594

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* Summer residential population.

Cold weather population of Mussoorie ... 6,550

Ditto Naini Tal ... 10,272

† Rs. 1,146 deducted on account of house connection charges.

APPENDIX No. II.

Annual maintenance accounts of water works in the United Provinces during the year 1911-12.

Nature of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. *Establishment—*								
(*a*) Permanent establishment.	24,082	23,056	26,254	30,896	22,996	10,737	15,741	8,607
(*b*) Office contingencies,	2,119	534	827	606	497	4,998	...	56
(*c*) Rents	...	3,770	240	...	648	360	...	...
2. *Pumping—*								
(*a*) Coal	27,724	18,951	20,046	29,576	34,734	500	2,600	16,079
(*b*) Oil and waste ...	2,839	1,090	4,026	2,488	1,456	429	1,557	1,042
(*c*) Other stores ...	3,175	1,831	4,395	6,874	1,121	2,502	...	1,167
3. *Intake—*								
(*a*) Training river ...	...	...	...	...	...	...	...	...
(*b*) Clearing channels and wells.	2,499	10	267	404	...	50	...	...
4. *Settling tanks and filters—*								
(*a*) Clearing settling tanks.	...	675	4,040	403	3,571	50	...	...
(*b*) Clearing and renewing filter beds.	1,925	980	1,975	5,976	150	2,532	...	4
(*c*) Purchase of sand ...	12,235	877	1,833	11,986	295	...	...	...
5. *Distribution—*								
(*a*) Pipes and fittings ...	859	3,359	3,419	5,642	1,625	1,976	733	3,631
(*b*) Meters ...	1,896	1,860	...	1,817	7,543	...	254	2,808
6. *Repairs—*								
(*a*) To tanks ...	226	...	200	...	...	...	...	...
(*b*) To buildings and grounds.	206	669	1,429	692	279	1,102	4,184	441
(*c*) To machinery ...	6,069	6,906	12,840	7,636	1,307	...	1,819	9,832
7. *Water analysis—*	210	589	1,271	205	225	270	150	427
Total ...	86,064	65,157	83,062	105,201	76,447	25,506	27,038	44,094

APPENDIX No. III.

Statement showing the initial capital cost of subsequent extensions and improvements incurred on water works in the United Provinces, up to the 31st March 1912.

Water works stations.			Initial capital cost.	Cost of subsequent extensions.	Cost of extentions during the year 1911-12.	Total.
			Rs.	Rs.	Rs.	Rs.
Agra	...	...	11,70,761	6,28,359	7,031	18,06,151
Allahabad	...	...	16,24,061	1,70,535*	18,326	18,12,922
Benares	...	...	25,61,881	4,44,887	40,734	30,47,502
Cawnpore	...	...	14,44,570	2,52,422	96,930	17,93,922
Lucknow	...	...	15,15,736	2,66,438	1,12,401*	18,94,575
Meerut...	...	...	7,51,710	30,738	4,798	7,87,246
Mussoorie	...	...	1,14,014	12,856	...	1,26,870
Naini Tal	...	...	2,47,000	3,28,237	6,387	5,81,624

* Rs. 26,778 from revenue.
,, 53,144 from Government grant.
,, 32,479 from loan.

APPENDIX IV.

Statement showing rate of filtration and results of water works of the United Provinces, during the year 1911-12.

Municipalities.		Rate of filtration per square foot in 24 hours.			Chemical analysis.			Bacteriological tests.	
		Maximum.	Minimum.	Average	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.
Agra ...	...	32	28	24	2	...	2	35	...
Allahabad	...	46·19	17·62	25·59	2	...	2	287	69
Benares	...	45·	24·	32·15	14	...	14	354	50
Cawnpore	...	39·	27·	34·06	2	...	2	164	7
Lucknow	...	29·1	16·2	22·10	5	...	5	377	50
Meerut	...	35·73	11·50	20·21	3	...	3	197	1
Mussoorie	...	...	...	...	...	...	...	...	...
Naini Tal	...	...	...	...	7	...	7	...	...

APPENDIX

Details of Pumps, Filters, Tanks, Reservoirs, Risi

Particulars.	Agra.	Allahabad.	Benares.
1. Consumption of water per capita in gallons.	13·46	11·60	21·69
2. Number of inhabitants drawing their supply of water from the mains.	1,85,449	171,697	199,868
3. Water used for irrigating and manufacturing purposes.	232,189,000	196,557,565	27,897,000
4. Power of pumps per hour in gallons at river.	2 Horizontal pumps each— Designed for 84,000 Maximum ... 96,000 Average ... 78,000 I Worthington low duty pump Designed for 120,000 Maximum ... 132,000 Average ... 102,000	Designed for 126,000 Maximum ... 154,961 Average ... 114,862	Designed for 252,000 Maximum ... 189,140 Average ... 172,383 1 Worthington high Duty pumping engine designed for gallons ... 500,000
5. Horse power each engine is designed for,	2 Horizontal pumps of 28 horse power each. 1 Worthington low duty engine of 31 horse power.	2 Engines of 102 horse power each.	2 Horizontal engines 141 horse power each. 1 Worthington high duty engine.
6. Power of pumps per hour in gallons at filter.	2 Beam engines each Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1 High duty Worthington. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	Designed for 223,300 Maximum ... 265,000 Average ... 188,453	Designed for 462 ,000 Maximum ... 455,809 Average ... 375,150
7. Horse power each engine is designed for.	1 High duty Worthington of 130 horse power. 2 Beam engines of 100 horse power each.	2 Engines of 135 horse power each.	4 Beam engines of 144 horse power each.
8. Number of rising mains ...	2	1	2
9. Length of rising mains ...	2·5 and 1·75 miles respectively.	1·9 miles	·82 and ·94 miles respectively, i. e. Old Rising main 4727′ New " " 4100′
10. Size of rising mains ...	28″ and 18″	20″	Both 24″
11. Number of settling tanks ...	5	3	3
12. Size of settling tanks ...	Each 266′ × 151′ Capacity of each 2,200,000 gallons.	Each 280′ × 180′ Capacity of nos. 1 and 3=2,733,065 gallons, and that of no. 2 =2,819,243 gallons.	(288′ +20′)×(238′+ 20′)×15′. Capacity of Nos. 1 and 3=6,436,120 gallons, and that of no. 2. =6,503,927 gallons.
13. Number of filters	7	5	8
14. Size of filters	Each 200′ × 10′	200′ ×100′	200′ × 100′ ×6′—4½″
15. Number of C. W. reservoirs	3	2	2
16. Size of C. W. reservoirs.	103′ × 105′ ×10′	Each 160′×103·3′×12′ Capacity ... 1,168,700	(178′—4″)×(148′—4″) ×(16′—1″). Capacity 1,879,631 gallons.
17. Number of service reservoirs or stand pipes.	43 four-tap standposts each ¾″ size ; 62 two-tap standposts of ¾″ size 151 one-tap standposts.	49 four-tap standposts, 54 two-tap standposts and 123 one-tap standposts each of ¾″ size.	242 one-tap standposts, 105 two-tap standposts 79, four-tap standposts.

No V.

ains, &c., in the Water Works of the United Provinces, for 1911-12.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
24·8	9·3	9·40	7·28	5·89
157,040	259,798	115,808	*11,000	*18,027
360,149,986	150,000,000	9,385,820	...	429,160
Two pumps each— Designed for 187,500 gallons.	Designed for 187,500	Designed for 72,000	Designed for 2,500	Lake station 14,355
Maximum 187,500 gallons.	Maximum 188,237	Maximum 61,985	Average ... 2,400	Baranadi Springs 13,326
Average 165,000 gallons.	Average 178,517	Average ... 37,037	Maximum ... Not known.	
2 Engines of 86 horse power each.	2 Engines of 130 horse power each.	1 Engine of 26 horse power. 2 Turbines each of 90 horse power.	Each motor pump designed for 150 horse power.	31 horse power.
Two pumps each—	Designed for 187,500	Designed for 66,000	...	...
Designed for 187,500	Maximum Not known.	Maximum ... 50,611	...	
Maximum 187,500	Average 117,028	Average ... 30,327	...	
Average 174,375				
2 Engines of 80 horse power each.	2 Engines of 110 horse power each.	...	...	...
2	1		1	4
1·32 miles	3·5 miles	15″ main=38,292′ 13″ main=8,550′	1·18 miles.	Ayarpatta ·93 miles. Tonnochy ·66 „ Pilgrim ·34 „ Lake ·19 mile.
Each 20″ dia.	20″	13″ and 15″	3½″	4″, 3½″, 3″, 4″
3	3	3	...	...
Each 355′ × 255′ capacity 3 million gallons.	250′ × 200′	100′×60′×11′	...	...
7	5	4	...	1 Jewel filter 12′ dia
200′×100′	200′×100′	150′×100′	...	...
2	2	1	1	5
Each 135′×106′—8″ ×12′ deep. Capacity of each 953,300 gallons.	Each 105′×107′	48′×52½′	80′×24′×6′	...
107—4 tap standposts 62—2 ditto 37—1 ditto 50′—6″ high×36′ dia.	150 one-tap, standposts; 238 two-tap standposts.	34 one-tap standposts of ¾″, 90 two tap standposts of ¾″. 2 wall fountains	8 iron tanks each 8′×4′×4′, 8 standpipes of 2 taps.	64 service tanks, 27 standposts.

* Summer population.

APPENDIX

Details of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.
18. Size of service reservoir ...	66′ dia. × 11′–4″ deep	60′ dia. × 11′ deep.	60′ dia. × 15′ deep Capacity 260,000 gallons.
19. Lift of pumps from river to settling tanks.	45 feet head	94′	79·64
20. Lift of pumps from filter water pump to town distribution.	147 „	76′	70·74
21. Cost of supplying water per 1,000 gallons.	1·20 annas	1·12 annas	·80 annas
22. Cost of supplying water per 100′ lift.	·625 „	·660 annas	·53 annas

No. V.

ins, &c., in the Water Works of the United Provinces, for 1911-12—(concluded).

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
Holds 320,000 gallons	66′×12′	2—Each 25′ + 34′	...	28 Round service tanks 3′×3′, 28 round service tanks 2′—8″ × 3′, 8 square tanks 6′×8′×4′.
86·4′	115′	15·16′	...	From collecting reservior to Tonnochy ...1,160′ Ayarpatta ...1,093′ Pilgrim ... 240′
57·2′	80′	133·98′	...	...
1·30 annas	1·37 annas	·96 annas	15·8 annas	Re. 1·38
...	·78 annas	·64 annas	·93 annas	„ 0·14

APPENDIX No. VI.

Detailed statement showing the expenditure incurred on works of a sanitary nature, executed under the supervision of Sanitary Engineer during the year 1911-12.

Name of Municipality.	Expenditure incurred on—			Total expenditure.
	Water works.	Drainage works	Other works.	
	Rs.	Rs.	Rs.	Rs.
Agra	7,031	2,990	1,311	11,332
Benares	...	64,149	34,574	98,723
Lucknow	85,623	2,17,351	...	3,02,974
Kanauj	...	16,450	...	16,450
Naini Tal	6,091	21	20,440	26,552
Farrukhabad	...	8,843	...	8,843
Hathras	...	4,810	...	4,810
Hardoi	...	...	10,384	10,384
Mirzapur	55,588	...	...	55,588
Ferozabad	...	55.031	...	55,031
Debra Dun	2,280	84	...	2,364
Budaun	...	1,500	...	1,500
Moradabad	...	1,42,347	...	1,42,347
Total ...	1,56,613	5,13,576	66,709	7,36,898

C. H. WEST,
Sanitary Engineer to Government, United Provinces.

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Serial [illegible]
Received 19

SIXTEENTH ANNUAL REPORT

OF THE

SANITARY ENGINEER

TO

GOVERNMENT, UNITED PROVINCES.

FOR THE YEAR ENDING 31st MARCH 1911.

ALLAHABAD:
PRINTED BY W. C. ABEL, OFFG. SUPDT., GOVERNMENT PRESS, UNITED PROVINCES.
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1911.

Sixteenth Annual Report of the Sanitary Engineer to Government, United Provinces, for the year ending the 31st March 1911.

The post of Sanitary Engineer, United Provinces, was held by Mr. W. G. Wood throughout the year. In addition to the eight waterworks stations the following places—Bareilly, Budaun, Bhawali, Bhamiadar (Naini Tal district), Dehra Dun, Etawah, Firozabad, Fatehpur, Jaunpur, Khurja, Gonda, Moradabad, and Rikhikesh,—were visited by the Sanitary Engineer for the purpose of inspecting works or advising municipalities on sanitary schemes.

The following officers were employed during the year on construction of works or preparation of projects :—

Mr. H. E. Parker, Assistant Sanitary Engineer, was employed on drainage project work for Aligarh, Atrauli, Hardwar and Lucknow Government House and in carrying out the Dehra water supply scheme.

Mr. A. K. Nandi, Assistant to the Sanitary Engineer, was employed on drainage projects for Meerut, Jhansi, Dhampur and Rikhikesh.

Mr. H. J. Amoore was employed on the preparation of the Mirzapur water works scheme, he has since reverted to ordinary Public Works department duties and will probably be employed again in carrying out this work.

Mr. A. E. J. Hubbard, Temporary Engineer, is in charge of the construction of drainage works at Moradabad under the Sanitary Engineer; this work is still in progress.

Mr. R. Miles, Temporary Engineer, is in charge of the Firozabad drainage works under the Executive Engineer, Agra division; this work is still in progress.

Mr. A. Woods, Assistant Engineer, was engaged for a few months in completing a portion of the Budaun drainage scheme which has been taken up. He has since reverted to ordinary Public Works department duties.

In addition to the above, surveyors and draftsmen, averaging about 22 in number, were employed on the preparation of plans and surveys.

Bhagwan Das, Surveyor, was in charge of the Fatehgarh drainage works and he carried these out both economically and well.

The interest shown by municipalities in sanitary matters continues to increase, many of the larger municipalities sent in proposals for improving their drainage and water supply schemes and several small municipalities notified areas, and Act XX Towns asked for maps and drainage schemes.

The following drainage and waterworks projects were prepared during the year and sent to the municipalities concerned :—

Mirzapur waterworks	599,492
Aligarh drainage scheme	630,414
Atrauli do.	188,355
Hardwar do.	88,998
Meerut do.	669,823
Jhansi do.	564,629
Dhampur do.	70,281
Rikhikesh improvement	101,571
Lucknow Government House	15,125

Survey plans of the following municipalities—Almora, Etah, Tilhar—were prepared and sent to the boards concerned.

In addition to the above, important sanitary work was done at Benares, Allahabad and Lucknow, through the Municipal Engineers in opening out new streets through congested parts of the city and in building model shops and markets. Most of these city improvement schemes, besides being of material benefit, appear to have been financially sound as many of the improvements have been made to pay for themselves.

The programmes of sanitary drainage schemes required by the Sanitary Board were drawn up, and will be found in appendices.

As regards water and drainage works in the larger municipalities there were no serious accidents anywhere, and the working of these has been satisfactory.

The extension of mains and the great increase in the number of meter connections at all stations as compared with the figures for last year show that prompter measures are taken to prevent waste, and that the increased consumption is due to a legitimate demand.

Dealing with the large municipalities singly we find—

Agra.—The engines at both waterworks stations were overhauled during the winter and all worn parts renewed. The High Duty Worthington engine continued to work economically and well. There was an increase in the demand for house connections and for extensions to the water supply. At present the engines can barely keep up sufficient pressure in the mains during the hours of maximum demand. A proposal for constructing a large new balancing tank, somewhere near the Thomason Hospital, is being submitted. This, if constructed, should ensure better pressure in the mains and relieve the engines at the filtered station considerably. There is another proposal under submission for bringing a supply of Ganges canal water to the unfiltered station by gravity, the object of this is to relieve the strain on the engines at the unfiltered station and to ensure a better supply than can be got at present when the river is low.

The drainage works at Agra are said to be working satisfactorily. There was an increase of Rs. 1,000 in the income of the sullage farm, though about four acres of the farm land was cut away by the river and some of the piping was submerged.

Allahabad.—The engines at the waterworks stations were all examined by Messrs. James Simpson & Co., during the cold weather. The report submitted by them is still under consideration of the Municipal Board and the Collector. Early action is very necessary to put the machinery at these stations into satisfactory order.

During the year a permanent extension of the water mains was made to the Sobatia Bagh portion of the civil station and a temporary extension to the Magh Mela grounds.

A new oil engine costing Rs. 11,500, for supplying Jumna water to the Alfred Park is under erection. The larger proposal for supplying unfiltered water to all public gardens and grounds which had been under consideration for some years has been dropped.

The drainage project of the Allahabad municipality prepared by Messrs. Lane-Brown and Hewlett was revised during the year under instructions of the Sanitary Engineer and has been sent to the Municipal Board for approval. The question of a satisfactory means of carrying the sullage across the Jumna has yet to be settled.

Considerable progress was made on the new road connecting the East Indian Railway and Bengal and North-Western Railway goods shed. This will be most useful in opening out a congested part of the city.

Benares.—The erection of the new High Duty Worthington engine was completed, but the final report on its working is awaited. The trials will take place as soon as certain petty adjustments necessary on the pumping engines have been carried out by the contractors. The new steel (lock-bar) rising main, when connected with the delivery pipe of the new pump, leaked badly at first but the leakages have now been stopped. A new pump barrel was fitted to one of the engines at the filtered station. The existing mains have been increased by a length of 2,847 feet. Proposals for putting a new intercepting sewer pipe along the face of the Ganges between Dassaswamed and Trilochan Ghats, and for constructing a new sewer between orderly bazar and the main sewer were prepared and submitted for sanction as well as projects for the drainage of several areas in the pakka mahals on the river side of the ridge. Useful work has been done in opening out a new road to the Bengal and North-Western Railway goods shed and in constructing a new municipal market and certain lines of shops on the new road. The water supply of Benares is as yet unmetered, it would be a great advantage to have venturi meters fixed at both pumping stations so that an accurate record of the work done could be maintained.

Cawnpore.—The engines at both stations were overhauled and repaired and a sufficient supply of spare parts were got in for stock.

The demand for water at Cawnpore has now got beyond the maximum daily supply of the present plant and proposals for increasing the maximum daily supply from four to seven million gallons have been submitted for sanction by the board. These proposals include the introduction of the Puech Chabal system of filtration. The cost of adopting the Puech Chabal filters will be 177,000 and the total cost of the whole scheme will amount to $6\frac{2}{3}$ lakhs.

The drainage system worked quite well during the year. The sewerage pumping engines at Permat Ghat worked on an average $13\frac{1}{2}$ hours a day and gave no trouble.

Meerut.—The water supply was excellent and the machinery in very good order. A few extensions were made to the pipe lines costing Rs. 3,382, the cost of this was met from revenue.

Lucknow.—The engines at both water works stations worked well throughout the year, but unfortunately serious cracks were found in both pump barrels at the unfiltered station. These have been patched up and new pump barrels have been ordered.

A project for a new boiler and pumping engine at the unfiltered station at Gaughat, amounting to Rs. 1,07,000, has been sanctioned and the work put in hand.

Two new filters have been erected and brought into use.

A proposal is under consideration to erect a new balancing tank. This, if constructed, should relieve the strain on the engines a good deal and ensure a more uniform pressure on the mains.

As regards drainage works at Lucknow the Ghasyarimandi and Husainganj drainage works are about three-fourths done and the balance should be completed soon. The sullage is now no longer treated in the septic tanks and filters but passed into the sewers direct and conveyed to the sullage farms at Gullalahar and the Wingfield Park. These farms are working very well, but there are times when the sullage is not needed by the cultivators, and at such times the sullage outfalls become very foul. It is necessary for the municipality to acquire a few acres of land for treatment of the sullage when it is not needed for cultivation.

A proposal for improving the portion of the Ghaziuddin Hyder canal which runs through Lucknow has been prepared and sent up for sanction.

Mussooree.—The pumping plant worked well throughout the year and there was no serious breakdown either in the electric plant or in the pumps themselves.

In view of the extreme hardness of the pumped water at Mussooree, a proposal to provide a suitable softening plant was made but it was dropped, as the cost, as reported by the Paterson Engineering Co. (about Rs. 25,000), was more than the municipality could afford. The work in connection with the Hydro-Electric Scheme is now completed and the completion report is under preparation.

Naini Tal.—The engines and boilers at the pumping station were examined by Messrs. James Simpson & Co. and the necessary repairs recommended which include the reboring of the cylinders and supply of new pistons and valves for the three engines are now in hand. It is anticipated that there will be an appreciable saving in steam consumption when the repairs are completed.

It would be a great advantage if the boilers could be fitted with mechanical stokers. This would give an appreciable saving in the cost of coal consumed which is very expensive up here and do away with the smoke nuisance; the cost would probably be about Rs. 3,000 for each boiler or Rs. 9,000 in all. This is beyond the means of the municipality at present.

During the hot weather the rising mains gave a good deal of trouble by leaking at the joints, these have now been relaid and American fibre rings used for packing instead of rubber ring with favourable results.

A jewel filter plant has been erected at Naini Tal at a cost of Rs. 38,797 and is giving satisfaction.

Moradabad.—The drainage works are progressing satisfactorily, about three-fourths of the estimated work has been completed and the remainder should be finished within a year.

About 100 feet of the outfall of the eastern main was carried away by an exceptional flood in the Ramganga river. The necessary repairs have been effected and the outfall is not likely to be again damaged.

Jaunpur.—The drainage works here are practically completed, an estimate amounting to Rs. 34,272, for special flushing arrangements has just recently been sanctioned and the work is in hand.

Budaun.—The portion of the drainage scheme taken up by the municipality has been completed with a saving of Rs. 2,750 which is being utilized on petty additional work.

Firozabad.—The work has been carried out as far as funds are available. A grant of Rs. 9,000, by the Sanitary Board at the end of last year, enabled the work to be continued as there is a likelihood of further funds being available, the work should be completed by March 1912.

At *Nagina* repairs and metalling of streets and roads were carried out at a cost of Rs. 30,132.

The Dehra Dun waterworks were completed under Mr. H. E. Parker, and those at Mirzapur are to be started under Mr. H. J. Amoore.

In addition to the above works a few sites in the hills were inspected and reported on by the Sanitary Engineer for the King Edward Sanatorium Committee with a view of selecting a suitable site for a sanatorium for consumptives.

It will be seen that while steady progress has been made during the year on the preparation of projects and the construction of sanitary works, the amount of work which can be usefully undertaken is limited by the project staff and funds available. Most municipalities are anxious to improve their present drainage system and construct new drains on scientific lines, but few can face the expense of doing so. In a few instances municipalities with funds available have put aside large comprehensive drainage schemes as unworkable, because the total expenditure proposed is more than they can afford. Though it is necessary to prepare a comprehensive drainage scheme as a whole there is no reason why it should be carried out as a whole. The more urgent and important parts of a scheme can be taken up first and the rest left for a more favourable opportunity or postponed indefinitely. All that is necessary is that the levels should be worked so that each portion of a scheme as carried out will fit into its right place in a comprehensive scheme as a whole. If this point is clearly understood the objection to having a complete and comprehensive scheme will to a great extent disappear, as it does not involve a municipality in any liability for carrying out work which though included in the estimate it does not propose to do.

On page 14, Appendix VI, is a statement showing the total expenditure on original works only carried out under the supervision of the Sanitary Engineer, which comes to Rs. 7,65,786, the expenditure on maintenance of water works is shown in Appendix II, page VIII, the expenditure on maintenance of drainage works has not been separately shown.

C. H. WEST, Supdg. Engr.,
Officiating Sanitary Engineer to Govt., Uited Provinces.

APPENDICES.

APPENDIX

UNITED PROVINCES

Statement of operations

Particulars.	Agra.	Allahabad.	Benares.
Population.			
By Census of 1901 in Municipality ...	1,65,981	159,545	208,121
Ditto Cantonments ...	22,041	12,487	4,958
Number of inhabitants drawing their supply from mains.	1,88,022	172,032	208,121
Consumption of water.			
During the year including Cantonments, gallons	1,033,875,100	835,347,429	1,528,833,790
Daily average including Cantonments, „	2,832,535	2,288,620	4,188,585
Maximum daily average in any one month „	3,626,200	2,927,398	5,189,114
Water used for irrigation and manufacturing purposes, gallons	142,356,475	57,255,000	13,446,375
Water used for domestic purposes, gallons	891,518,625	778,092,429	1,515,387,415
Water consumed per capita „ ...	12·9	12·32	19·48
Daily average for Cantonments alone „ ...	215,087	169,904	1,508
Number of house connections during 1910-11 ...	1,750	2,868	7,808
Number of metered connections	68	328	7
Annual receipts and charges.			
Maintenance charges ... ... Rs.	80,387	55,546	84,245
Cost per 1,000 gallons consumed	1·24 annas	1·06 annas	·88 annas
Cost per 1,000 gallons per 100 feet lift ...	·645 annas	·625 annas	·58 annas
Cast of water per 1,000 gallons including interest and sinking fund charges.	2·80 annas	3·102 annas	1·84 annas
Lift of pump.			
From river to settling tanks	45 feet	93·43 feet	78·08 feet
From filtered water pumps to town distribution	147 feet	75·91 feet	69·98 feet
Total lift ...	192 feet	169·34 feet	148·06 feet
Income from waterworks.			
Water rate recovered during the year ... Rs.	80,103	89,778	98,733
Sale of water and other receipts ... Rs.	30,584	37,844	8,968
Total income ... Rs.	1,10,687	1,27,622	1,07,701

Summer residential

Cantonments not

Cold weather populat

„ „

(1) These refer only to the pumped supply and not

No. I.

WATERWORKS.

during the year 1910-11.

Cawnpore.	Lucknow.	Meerut.	Mussooree.	Naini Tal.
172,674	240,568	78,740	14,689	14,220
24,496	23,407	30,389	3,711	914
172,674	263,975	118,129	14,689	15,164
1,326,747,895	812,514,411	345,625,449	22,955,480	23,103,821
3,634,926	2,226,067	946,919	62,892	63,298
4,296,054	3,425,996	1,592,123	86,476	230,951
316,800,333	157,608,000	5,129,670	Nil	94,830
1,009,947,562	654,906,411	340,495,779	22,955,480	23,008,991
16·02	8·5	7·89	(1) 4·28	perdiem 5·2
...	910,111	348,854	643 gallons	2,672
1,711	629	429	111	169
437	112	30	112	168
Rs. 113,902	66,663	*22,376	21,374†	42,095
1·49 annas	1·3 annas	1·04 annas	14·89 annas	1·82 annas
...	·78 annas	·74 annas	·87 annas	·19 annas
2·23 annas	2·91 annas	3·35 annas	Rs. 2·54	Rs 3·31
88·51 feet	104·2 feet	15·16 feet	Nil	Nil
56·91 feet	75·6 feet	125·25 feet	1,700′	Tonnochy... 1160 Ayarpatta... 1093 Pilgrim ... 240′
145·42	179·8 feet	140·41 feet	1,700′ from collecting reservoir to town distribution.	2493′
Nil	31,437	Nil	Nil	26,306
83,190	70,218	40,028	5,621	8,711
83,190	101,655	40,028	5,621	35,017

population.

included.

of Mussooree ... 4,741.

Naini Tal ... ... 6,908.

to that made by gravitation or other services,

which amounts to Rs. 6144.

house connection charges,

C. H. WEST, Supdg. Engr.,

Offg. Sanitary Engineer to Government, United Provinces.

APPENDIX No. II.

Annual maintenance accounts of waterworks in the United Provinces during the year 1910-11.

Nature of charges.	Agra.	Allahabad.	Benares.	Cawnpore.	Lucknow.	Meerut.	Mussooree.	Naini Tal.
	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.	Rs.
1. *Establishment—*								
(*a*) Permanent establishment.	22,985	24,111	25,543	27,162	24,421	10,466	‡13,316	8,979
(*b*) Office contingencies,	2,391	492	800	385	341	5,187	35	139
(*c*) Rents	...	300	...	...	20	360	...	...
2. *Pumping—*								
(*a*) Coal	30,442	12,789	30,684	38,725	24,751	...	...	20,019
(*b*) Oil and waste ...	2,918	1,112	3,051	2,253	1,402	426	...	695
(*c*) Other stores ...	2,638	1,078	3,069	3,252	1,298	2,589	406	711
3. *Intake—*								
(*a*) Training river ...	...	...	...	1,523	...	...	148	
(*b*) Clearing channels and wells.	3,146	13	93	604	...	50		...
4. *Settling tanks and filters—*								
(*a*) Clearing settling tanks.	998	506	3,415	511	1,527	50	14	...
(*b*) Clearing and renewing filter beds.	1,507	616	3,727	4,860	372	1,526	...	
(*c*) Purchase of sand,	8,400	668	2,667	9,748	1,947	...	...	373*
5. *Distribution—*								
(*a*) Pipes and fittings ...	1,023	3,554	2,279	5,701	2,045	3,490	222	4,406
(*b*) Meters	472	2,243	...	10,753	3,228	...	...	1,554
6. *Repairs—*								
(*a*) To tanks	234	...	79	82	435	41	...	37
(*b*) To buildings and grounds.	414	487	1,460	915	753	946	701	729
(*c*) To machinery ...	1,843	7,103	5,942	6,520	2,687	...	369	2,819
7. *Water analysis* ...	926	474	1,436	908	1,436	750	19	1,643
Total ...	80,387	55,546	84,245	1,13,902	66,863	25,881†	15,230§	42,095

* Purchase of alumina.
† Including Rs. 3,505 on account of house connection charges.
‡ Including temporary establishment.
§ Excluding electric works maintenance which amounts to Rs. 6,144.

C. H. WEST, SUPDG. ENGR.,
Offg. Sanitary Engineer to Government, United Provinces.

APPENDIX No. III.

Statement showing the initial capital cost and cost of subsequent extensions and improvements incurred on waterworks in the United Provinces up to 31st March 1911.

Waterworks Stations.			Initial capital cost.	Cost of subsequent extensions.	Cost of extension during the year 1910-11.	Total.
			Rs.	Rs.	Rs.	Rs.
Agra ...	...	...	11,70,761	6,24,921	3,438	17,99,120
Allahabad	...	...	16,24,061	1,51,474	19,061	17,94,596
Benares ...	...	...	25,61,881	4,22,369	22,518	30,06,768
Cawnpore	...	...	14,44,570	2,49,222	3,200	16,96,992
Lucknow	...	...	15,15,736	2,10,425	56,013	17,82,174
Meerut ...	...	...	7,51,710	27,356	3,382	7,82,448
Mussooree	...	...	1,44,014	10,876	1,980	1,56,870
Naini Tal	...	...	2,47,000	2,96,158	32,079	5,75,237

APPENDIX IV.

Statement showing rate of filtration and results of waterworks of the United Provinces during the year 1910-11.

Municipalities.		Rate of filtration in gallons per square foot in 24 hours.			Chemical tests.			Bacteriological tests.	
		Maximum.	Minimum.	Average.	Good.	Bad.	Total.	Number of tubes sent to Chemical Examiner.	Number containing over 100 colonies.
Agra ...	...	35	28	30·4	10	3	13	27	
Allahabad	...	36·26	12·59	28·8	...	...	...	230	*nil*
Benares	...	45	22	31·5	46	1	47	311	15
Cawnpore	...	50	27	30·7	1	...	1	192	2
Lucknow	...	38	14	23·7	58	2	60	358	7
Meerut	...	30	·96	15·8	48	1	49	200	*nil*
Mussooree	...	...	...	...	...	...	...	...	...
Naini Tal	...	...	...	...	5	...	5	...	...

C. H. WEST, SUPDG. ENGR.,
Offg. Sanitary Engineer to Government, United Provinces.

APPENDIX

Detail of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.
1. Consumption of water per capita in gallons.	12·9	12·32	19·48
2. Number of inhabitants drawing their supply of water from the mains.	188,022	172,632	208,121
3. Water used for irrigating and manufacturing purposes.	142,356,475	57,255,000	13,446,375
4. Power of pumps per hour in gallons at river.	2 Horizontal pumps each— Designed for... 84,000 Maximum ... 96,000 Average ... 78,000 1 Worthington Low Duty pump. Designed for 120,000 Maximum ... 132,000 Average ... 102.000	Designed for 126,000 Maximum ... 129,953 Average ... 103,882	Designed for 252,000 Maximum ... 189,140 Average ... 172,383 1 Worthington High Duty pumping engine designed for 500,000.
5. Horse power each engine is designed for.	2 Horizontal pumps of 28 horse power each. 1 Worthington Low Duty engine of 31 horse power.	2 Engines of 102 horse power each.	2 Horizontal engines 141 horse power each. 1 Worthington High Duty pumping engine.
6. Power of pumps per hour in gallons at filter.	2 Beam engines each Designed for 192,000 Maximum ... 200,000 Average ... 180,000 1 High Duty Worthington. Designed for 150,000 Maximum ... 156,000 Average ... 144,000	Designed for 223,320 Maximum ... 260,800 Average ... 168,253	Designed for 462,000 Maximum ... 455,809 Average ... 375,150
7. Horse power each engine is designed for.	1 High Duty Worthington of 130 horse power. 2. Beam engines of 100 horse power each.	2 Engines of 135 horse power each.	4 Beam engines of 114 horse power each.
8. Number of rising mains ...	2	1	2
9. Length of rising mains ...	28″ Main ... 15,620′ 18″ Rider ... 9,240′	10,032′	Old rising main 4,727′ New rising main 4,100′
10. Size of rising mains ...	28″ and 18″	20″	Both 24″
11. Number of settling tanks ...	5	3	3

No. V.

Mains, &c., in the Waterworks of the United Provinces for 1910-11.

Cawnpore.	Lucknow.	Meerut.	Mussoorie.	Naini Tal.
16 02	8·5	7·89	4·28	5·2
1,72,674	263,975	118,129	*14,639	15,164
3,168,00,333	157,608,000	5,129,670	Nil	94,830
Two Pumps each—Designed for 187,500 gallons. Maximum 157,500 gallons. Average 143,444 gallons for the year.	Designed for 187,500 Maximum 188,237 Average ... 178,517	Designed for 72,000 Maximum ... 61,985 Average ... 37,037	Designed for 10,800 at collecting reservoir. Maximum ... 11,700 Average ... 11,100	Lake station 14,355 Baranadi Spring 13,326
2 Engines of 86 horse power each.	2 Engines of 130 Indicated horse power each.	1 Engine of 26 horse power. 2 Turbines of 90 horse power each.	Each of the two motors designed for 150 horse power.	31 horse power
Two pumps each—Designed for 187,500 Maximum 199,736 Average for the year... 176,959	Designed for 187,500 Maximum. not known Average ... 117,028	Designed for 66,000 Maximum ... 50,611 Average ... 30,327	Nil	Nil.
2 Engines of 80 horse power each.	2 Engines of 110 indicated horse power each.	...	Nil	...
2	1	1	1	4
7,000′	18,830′	15″ main 38,292′ 13″ main 8,550′	6,000′	Ayarpatta ... 3,315′ Tonnochy ... 3,530′ Pilgrim ... 1,830′ Lake ... 1,025′
Each 20″ dia.	20″	15″ and 13″	5″	3½,″ 4,″ 3,″ 4″
3	3	3	Nil	Nil.

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* Summer residential population.

APPENDIX

Detail of Pumps, Filters, Tanks, Reservoirs, Rising

Particulars.	Agra.	Allahabad.	Benares.
12. Size of settling tanks ...	Each 266′×151′ Capacity of each 2,200,000 gallons.	Each 280′×180′ Capacity of Nos. 1 and 3=2,773,065 gallons, and that of No. 2 =2,819,243 gallons.	(288′ + 20′)×(238′ + 20′)×15′. Capacity of Nos. 1 and 3 =4,672,922 gallons, and that of No. 2. =4,724,227 gallons.
13. Number of filters ...	7	5	8
14. Size of filters	Each 200′×10′	200′×100′	200′×100′×6′—4½″
15. Number of C. W. Reservoirs	3	2	2
16. Size of C. W. Reservoirs ...	103′×105′×10′	Each 160′×103·3′×12′ Capacity ... 1,168,700	(178′—4″)×(148′—4″)×(16′—1″). Capacity 1,879,631 gallons.
17. Number of service reservoirs or stand pipes.	43 Four-tap standposts each ¾″ size; 62 two-tap standposts of ¾″ size, 150 one-tap stand posts.	81 Four-tap standposts, 50 two-tap standposts and 128 one-tap standposts each of ¾″ size. Kennedy's self closing push taps and waste not cocks, &c., 29. Wall box stand pipe 7.	237 One-tap standposts, 105 two-tap standposts, 73 four-tap standposts.
18. Size of service reservoir ...	66′ dia.×11′—4″ deep	60′ dia.×11′ deep	60′ dia.×15′ deep capacity 260,000 gallons.
19. Lift of pumps from river to settling tanks.	45′	93·43′	78·08′
20. Lift of pumps from filter water pump to town distribution.	147′	75·91′	69·98′
21. Cost of supplying water per 1,000 gallons.	1·24 annas	1·06 annas	·88 annas
22. Cost of supplying water per 100′ lift.	·645 annas	·625 annas	·58 annas

No. V.

Mains, &c., in the Waterworks of the United Provinces for 1910-11—(concluded).

Cawnpore.	Lucknow.	Meerut.	Mussooree.	Naini Tal.
Each 355′ × 255′ capacity 3 million gallons.	250′×200′	100′×60′×11′	Nil	Nil.
7	7	4	Nil	Nil.
200′×100′	200′×100′	150′×100′	Nil	Nil.
2	2	1	4	5
Each 135′×105′×12′ deep. Capacity of each 1,020,577 gallons.	Each 105′×107′	48′×52½′	1×80′×24′×6′ 2×40′×25′×8′ 1×30′×20′×8′	...
107—4 tap standposts 62—2 ditto 87—1 ditto Tower 50′—6″ high ×36′ dia.	154, one-tap standposts; 225 two-tap standposts.	32, one-tap standposts of ¾″; 86 two-tap standposts of ¾″. 2 wall fountains.	12 iron tanks, 29 standpipes of two-taps.	64 service tanks, 27 standposts.
Holds 320,000 gallons	66′×12′	2—Each 25′×34′	...	28 Round service tanks 3′×3′, 28 round service tanks 2′—8″×3′, 8 square tanks 6′×8′×4′.
88·51 feet	104·2′	15·16′	Nil	From collecting reservior to Tonnochy...1,160′ Ayarpatta...1,093′ Pilgrim ... 240′
56·91 feet	Average 75·6′	125·25′	1700′	...
1·49 annas	1·3 annas	1·04 annas	14·89 annas	1·82 annas
...	·73 annas	·74 annas	·87 annas	·19 annas

C. H. WEST, Supdg. Engr.,

Offg. Sanitary Engineer to Government, United Provinces.

APPENDIX No. VI.

Detailed statement showing the expenditure incurred on works of a sanitary nature, executed under the supervision of Sanitary Engineer, during 1910-11.

Name of municipality.	Expenditure incurred on—			Total expenditure.
	Waterworks.	Drainage works.	Other works.	
	Rs.	Rs.	Rs.	Rs.
Agra	3,438	5,204	...	8,642
Benares	...	47,708	1,04,562	1,52,270
Lucknow	50,908	2,05,418	...	2,56,326
Mirzapur	...	710	2,400	3,110
Farrukhabad	...	20,071	...	20,071
Dehra Dun	2,723	...	...	2,723
Moradabad	...	1,65,429	...	1,65,429
Aligarh	...	2,938	...	2,938
Hathras	...	2,910	...	2,910
Sardhana	...	1,170	...	1,170
Firozabad	...	43,368	...	43,368
Kanauj	...	4,965	...	4,965
Mainpuri	...	52	...	52
Atrauli	...	909	...	909
Dhampur	...	1,860	...	1,860
Jhansi	...	2,720	...	2,720
Fatehpur	...	978	...	978
Hardwar	...	716	...	716
Etah	...	638	...	638
Unao	...	713	...	713
Jaunpur	...	66,326	...	66,326
Tilhar	...	913	...	913
Nagina	...	26,039	...	26,039
Total ...	57,069	6,01,755	1,06,962	7,65,786

C. H. WEST, SUPDG. ENGR.,

Offg. Sanitary Engineer to Government, United Provinces.

APPENDIX

PROGRAMME OF SANITARY WORKS, UNITED

I.—WORKS TO

Name of places.	Description of work and its estimate.	Remarks by Government.	Replies received from the municipality on the three points raised below—		
			Funds available for the work.	Income with reference to the actuals of the preceding three years.	Method by which it is proposed to raise any additional income and method of repayment of loan, if taken.
			Rs.	Rs.	
1. Khurja ...	Drainage works costing Rs. 1,37,840.	Part of the cost would be met from the cash balance which at the close of the year 1908-9 amounted to Rs. 42,364 and a loan of a lakh would probably be necessary, the Board should be able to afford this.	44,000	54,973	By taking a loan of 1 lakh of rupees which will be repaid without levying fresh tax.
2. Hapur ...	Drainage works estimate, Rs. 2,08,893	In 1908 the Board had a surplus income of Rs 16,000 without allowing any sum for original works, but subsequently a decline in the octroi income disturbed the financial position. The Board should be able to finance the scheme but enquiry will be necessary before the project is placed on the programme.	41,000	1907—56,010 1908—45,189 1909—44,067	By taking a loan to be repaid by 40 half yearly instalments of equal amount.
3. Fyzabad ...	Drainage works estimate, Rs. 3,79,533 +1,71,481.	Nothing can be done towards the execution of the scheme till either taxation is raised or the Government is in a position to give assistance.	No funds. Nothing can be said towards the execution of the scheme till either taxation is raised or Government gives assistance.	1,12,574	Enhancement of octroi duty.
4. Saharanpur ...	Drainage works estimate, Rs. 3,69,808	The Board can finance the complete scheme.	1,61,000	1,47,545	Application made to Secretary, Sanitary Board, for a grant of Rs. 2,00,000. Will not take a loan but raise the octroi duty.
5. Shahjahanpur	Drainage works estimate, Rs. 6,57,416.	Here also the octroi figures vary a great deal from year to year so that it will be necessary to ask the Board to work out a normal budget and to state clearly its financial position.	8,000	1,39,000	...
6. Rikhikesh ...	Drainage works estimate, Rs. 1,01,571.	...	...	...	...
7. Almora ...	Drainage works estimate, Rs. 27,948.	The Municipal Board has decided to defer taking up the project till it has revised its system of taxation.	...	21,500	By taking loan and raising the income by additional taxation.
8. Kanauj ...	Drainage works estimate, Rs. 29,885.	The committee of the notified area could probably afford to undertake the scheme. But to defray the loan charges it will be necessary to slightly raise the incidence of taxation and the committee should be asked for its views.	5,000 a year	8,070	No loan will be taken. Income has been increased by raising taxation.
9. Etawah ...	Drainage works estimate, Rs. 3,69,095.	The Board can finance the complete scheme.	...	...	...
10 Mainpuri ...	Drainage works estimate, Rs. 2,66,693.	The present income is only sufficient for the ordinary expenditure, and taxation must be enhanced if the project is to be taken up. The Municipal Board should be addressed.	...	...	By taking a loan which can be repaid by enhancing the octroi duty.

No. VII.

PROVINCES, ARRANGED IN ORDER OF URGENCY.

BE UNDERTAKEN.

Remarks by Sanitary Engineer.	Remarks by Sanitary Board.
This project was prepared by Mr. Standley and sent in and sanctioned just after I took charge. I believe the municipality are thinking of starting on a portion of the work.	Class as ready and urgent.
The Collector of Meerut (Mr. L. Porter) pressed urgently for this project and it got out in record time in March 1909 and was finally sanctioned by Sanitary Board and Government. They intended to finance 1 lakh's worth of it *but nothing has been done.* The Board in letter no. 307, dated the 7th October 1910, said they had applied for 1 lakh loan in 1909. Rupees 12,000 for land and Rs. 7,735 for new station road has been made in the budget and the work is in progress. Therefore Rs. 19,735 should be excluded from the total amount.	Ditto.
This project has been finally passed by Government and Sanitary Board. But the Board so far have not been able to finance any part of it. I believe they intend to take up the Fatehganj nala portion which although forming part of the whole scheme is a separate piece by itself, but so far nothing has been started.	Ditto.
The final project is now before Government. The Board asked for Rs. 2,00,000 from the Sanitary Board to enable them to start.	
This scheme is now with the Municipal Board. They are awaiting the return of Mr. Tyler before doing anything further.	
This project has just been completed and submitted to Manager, Rikhikesh Improvement Fund.	Ditto.
This is a small scheme which the Board intend to carry out themselves. I am now preparing an accurate map for them which they asked for.	Ditto.
This work will probably be carried out slowly bit by bit by the Board's overseer. I am told the outfall advised and designed by me has been built. As the town itself possesses very steep gradients indeed, the project is really a simple one, and the smallest sort of drain carries away anything very quickly. If the outfall has been built, it is a step in the right direction.	Ditto.
This project, I fancy, the Etawah Board are not very keen on. I had a conference with the Collector a short time ago and they contemplate doing some portion of it and I do not think they wish to take a loan.	
This project takes in the whole of Mainpuri which makes the cost per head high. It can, of course, like all the projects, be taken up in blocks but so far they have not seen their way to financing any part of it.	Ditto.

APPENDIX

PROGRAMME OF SANITARY WORKS, UNITED

I.—WORKS TO BE

Names of places.	Description of work and its estimate.	Remarks by Government.	Replies received from the municipality on the three points raised below—		
			Funds available for the work.	Income with reference to the actuals of the preceding three years.	Method by which it is proposed to raise any additional income and method of repayment of loan, if taken.
			Rs.	Rs.	
11. Dhampur ...	Drainage works estimate, Rs. 70,281	The margin on the figure in the Secretariat is only Rs. 1,000 and before anything is done it will be necessary to ask the Board to explain how funds can be provided.	1,000	The annual charges exceed the income.	It is proposed to take a loan or levy any additional taxes.
12. Meerut ...	Drainage works estimate, Rs. 6,50,000.	Without any provision for original works the income exceeds the expenditure by Rs. 15,000 or 16,000 but some money must be set aside annually for works and the real margin is considerably less. If however the scheme is to be undertaken piecemeal this will not matter.	12,500	3,04,758	The work will be undertaken piecemeal and paid for from revenue.
13. Jhansi ...	Drainage works, Rs. 5,64,627.	The excess of income over expenditure is only sufficient to cover the charges on a loan of one lakh. The municipal board wanted drainage before water works. But it will be necessary to settle definitely what is to be done about waterworks scheme before the drainage project is taken up.	50,000	86,166	By loan and by additional taxation.
14. Allahabad ...	Drainage works, Rs. 18,32,628.	The Muncipal Board has been asked to clear up the financial position and a further communication will be made when their report is received.	20,000	5,67,341	Will not take a loan, ask Sanitary Board to make a grant of five lakhs.
15. Aligarh ...	Drainage works, Rs. 5,50,000.	The board can afford to take a loan of about 3½ lakhs and it has Rs. 28,200 invested. But if the whole scheme is taken up and further taxation is necessary, the municipal board must be addressed on the financial question.	90,000	54,540	It will probably be decided to take up the works by instalments and to finance it by small increases of taxation, but details cannot be given till the scheme is sent.
16. Fatehpur ...	Drainage works, Rs. 1,80,000.	The surplus of income over the expenditure is about Rs. 3,500 a year, the Municipal Board reported that it would take up work on the scheme from time to time as funds were available, and in view of this fact it is for the Sanitary Board to consider if the scheme should be proceeded with.	10,000	22,218	It is not proposed to take a loan or raise any additional income.

No. VII.

PROVINCES, ARRANGED IN ORDER OF URGENCY,

UNDERTAKEN—*(continued)*.

Remarks by Sanitary Engineer.	Remarks by Sanitary Board.
This scheme has lately been completed. It is a small municipality and will require help. It is a place to which a grant might well be given by the Board. The Board say that the scheme is not necessary but that if Government press for it, it must be done through a Government grant.	Classed as ready and urgent.
The project is now being completed. It will be a big project, but if the municipality can build its mains, the rest can be done block by block.	Ditto.
The scheme is approaching completion. They would like to spend about Rs. 25,000 annually and do the work gradually.	Ditto.
The scheme has now been revised by Messrs. Lane-Brown and Hewlett and is now with me. It is, I think, a considerable improvement on the original scheme and is some lakhs cheaper. But unless the municipality can finance a sum of about five lakhs not much can be done as the first works must be the pumping station and the sewage main across the Jumna. The Board have stated they are not in a position to finance further loans till 1921. They have asked *Government to come* to their assistance and make a special grant of five lakhs or some such sum as will enable them to make a start.	Ditto.
This scheme has lately been completed, and is now being considered by the board.	
This scheme is under preparation, and will be completed by the end of the year. The Board have Rs. 20,000. They propose to carry it out by their own agency piecemeal.	Ditto.

APPENDIX

PROGRAMME OF SANITARY WORKS, UNITED

I.—WORKS TO BE

Names of places.	Description of work and its estimate.	Remarks by Government.	Replies received from the municipality on the three points raised below.		
			Funds available for the work.	Income with reference to the actuals of the preceding three years.	Method by which it is proposed to raise any additional income and method of repayment of loan, if taken.
			Rs.	Rs.	
17. Hardwar' ...	Drainage works, Rs. 1,00,000.	The scheme should be explained to the Commissioner who will decide whether any part of its cost can be met from fair fund account. The balance in this account at the close of the year 1908-9 was Rs. 42,059 and the income exceeds the outlay by about Rs. 15,000 a normal budget of the ordinary income and expenditure indicates a surplus sufficient to cover the charges on a loan of a lakh, but this makes no allowance for original works.	Board can devote Rs. 10,000 during next year for the work.	1907-8—55,981 1908-9—54,791 1909-10—52,921	The Board suggests the work to be done in three years and is prepared to pay Rs. 30,000 and proposes that the balance Rs. 20,000 be met from the fair fund; it is not proposed to take a loan but to enhance the octroi duty on goods and the pilgrim tax.
18. Atrauli ...	Drainage works, Rs. 1,25,000.	On a normal budget, the marginal works work out to Rs. 2,000. The Board should be addressed.	14,000	17,013	It is not desired to take a loan or levy additional taxes.
19. Amroha ...	Drainage works, Rs. 2,67,543.	A normal budget indicates a possible surplus of only Rs. 3,000 and it seems necessary to ascertain from the Municipal Board in what stage it proposes to carry out the scheme and how provide funds.	...	...	Unable to carry out the scheme.
20. Landour ...	Drainage, Rs. 2,00,000	...	...	...	...
21. Lucknow ...	Water works, Gaughat, Rs. 4,00,000.	...	...	...	...
22. Naini Tal ...	Latrines and pail dépôts, Rs. 1,00,000.	...	...	...	...
23. Mirzapur ...	Waterworks, Rs. 6,32,000.	...	...	...	...
24. Benares ...	Sewerage and surface drainage scheme, Rs. 2,00,000.	...	...	...	...
25. Cawnpore ...	Improving conservancy tramway, draining Collectorganj and Lachmanparwa, Rs. 58,000.	...	...	...	...
26. Lucknow ...	Town improvement, Rs. 2,40,000.	...	...	...	...

No. VII.

PROVINCES, ARRANGED IN ORDER OF URGENCY.

UNDERTAKEN—*(concluded).*

Remarks by Sanitary Engineer.	Remarks by Sanitary Board.
This scheme is still under preparation and will be submitted about January ...	Classed as ready and urgent.
The scheme is nearly ready. This is a small municipality, and one that the *Sanitary Board might help. The Board say that they cannot finance it.*	Ditto.
The Board have definitely decided that the project is altogether too ambitious a one for them to attempt, and I rather agree with them as it involves pumping.	
...	Nos. 20 to 26 added by the Sanitary Board as being of importance. The projects however are not yet ready.
...	
...	
...	
...	
...	
...	

C. H. WEST, Supdg. Engr.,
Offg. Sanitary Engineer to Government, United Provinces.

APPENDIX

PROGRAMME OF SANITARY WORKS, UNITED

II.—PROJECTS

Names of places.	Description of work and its estimate.	Remarks by Government.	Replies received from the municipality on the three points raised below.		
			Funds available for the work.	Income with reference to the actuals of the preceding three years.	Method by which it is proposed to raise any additional income and method of repayment of loan, if taken.
			Rs.	Rs.	
1. Bahraich ...	Drainage project costing Rs. 4,14,372.	...	...	...	...
2. Benares ...	...	...	...	...	...
3. Muttra ...	Drainage works ...	...	No funds ...	24,200	Enhancement of octroi duty and raising a subscription.
4. Brindaban ...	Ditto ...	...	30,000 which is the amount allotted by the Sanitary Board.	...	Ditto ...
5. Etah ...	Ditto ...	...	...	...	The Board do not require a loan or any assistance in construction but propose to construct their own drains year by year out of current funds.
6. Ghazipur ...	Drainage works costing Rs. 4,35,688.	...	25,000	51,000	By further taxation and getting a loan of Rs. 75,000.
7. Tilhar ...	Drainage works ...	...	16,878	35,817	It is proposed to raise the income by further taxation.
8. Azamgarh ...	Ditto ...	...	...	...	...
9. Shahganj ...	Drainage work estimate, Rs. 60,000.	The statistics available here are insufficient to be the basis of a normal and the Committee of the notified area should be asked to explain its financial position.	...	9,144	By further taxation.
10. Shikohabad ...	Drainage works ...	...	...	...	...
11. Unao ...	Ditto ...	...	...	...	...
12. Gonda ...	Drainage ...	...	...	...	...
13. Gorakhpur improvement scheme.	...	...	...	...	...

No. VIII.

PROVINCES, ARRANGED IN ORDER OF URGENCY.

TO BE PREPARED.

Remarks by Sanitary Engineer.	Remarks by Sanitary Board.
The Board are now pressing to commence work on part of the scheme drawn up by Mr. Lane-Brown. Up to now I have not seen the scheme and have had no chance of *going to* Bahraich, *so that* I fear it must wait. But I will take an early opportunity of examining the scheme. I fear it will take some time to revise it in accordance with present instructions.	
I submitted two projects lately—one for the drainage of two areas in the pakka mahals, and one for the construction of a sewer to take the sullage of the *Orderly bazar* across the *Burna* river, and deliver it into the large main sewer	
I have so far been unable to examine this project. It is an old one of Mr. Lane-Brown's and will probably require to be revised in accordance with the present system.	
Ditto ditto.	
I have lately completed a map of this municipality, but so far have not commenced drawing up a project.	
I have been over Mr. Lane-Brown's project for this place; a good deal of it can, I hope, be utilized, but it will require a great deal of revision.	
The survey of this place has been made, but the mapping has been delayed owing to the surveyor having got ill, and he has not been able to do anything for 1½ months.	
I twice intended going to Azamgarh last cold weather, but the Collector was away on each occasion in camp, and told me the scheme was not urgent.	
A map exists, but I have not been able to take up any scheme yet.	
I have lately sent two surveyors to make a map of the place.	
...	Nos. 12 and 13 added by the Sanitary Board as being of importance.

C. H. WEST, Supdg. Engr.,
Offg. Sanitary Engineer to Government, United Provinces.